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INTRODUCTORY NOTE

While Dr. J. L. Moreno was visiting the University of Chicago in November, 1943, Professor Ernest W. Burgess introduced him to Professor W. C. Allee. During the ensuing discussion Dr. Moreno recognized the close relationship between the two sociometries, of the human and of the subhuman groups. He began to examine the possibility of closer collaboration between the two types of sociometry. With the aid of Mr. Robert C. Cook, Editor of the *Journal of Heredity,* to whom we are greatly indebted, the symposium took its present form.

SOCIAL LIFE AND INTERRELATIONSHIPS IN CERTAIN PROTOZOA

H. S. JENNINGS

University of California at Los Angeles

Protozoa are organisms consisting of a single cell. Such interest as their social life has is derived from that fact. The social phenomena that they show are not due to the organization and interaction of many cells of different types, such as are found in higher organisms, but are part of the life of the single cells.

Social life involves the reactions of individuals as such to each other; involves discriminatory reactions to different individuals. Such reactions occur in the Protozoa mainly in relation to reproduction, particularly in the mating that is a part of biparental reproduction.

In certain Protozoa the different individuals are differentiated into diverse sex types. These react to each other differentially, as do the individuals of different sex in higher animals. In the Protozoa the sex types differ only physiologically, in ways that condition their behavior, but not structurally. Such differential sex reactions are known in the flagellate infusoria (Chlamydomonas, Polytoma) mainly through the investigations of Moewus, Hartmann and other workers in Germany and in the Ciliate infusoria (Paramecium, Euplotes) through the work of Sonneborn, Jennings, Chen, Kimball, Gilman and other investigators in America. The differential sex behavior gives rise to rather complex social systems.

In most species and varieties that have been investigated there are two sex types, which show behavior reactions that are similar to those shown by the two sexes in higher organisms. This is true so far as studied for the Flagellates and some of the Ciliates, including Paramecium aurelia and P. caudatum. But in certain species, as in Paramecium bursaria and in Euplotes patella, there may be in any variety more than two sex types. Details concerning these are given in later paragraphs.

Social behavior, with differential reactions, are found mainly in the relations of individuals belonging to different sex types. Individuals of the same sex type do not react sexually together, do not conjugate. But individuals of different sex type, if they belong to the same variety, readily react sexually and conjugate.

The sexual reactions are of a striking character. When all the individuals present are of the same sex type, there is no reaction; the individuals remain scattered and separate and do not conjugate. But if with these are

mingled individuals of a different sex type, there is at once a remarkable change in behavior. The individuals of the different sex types adhere together, forming large clots. Each clot may include, under favorable conditions, hundreds of adhering individuals. At first the clots are small, but they increase rapidly in size. Later, after three or four hours or more, the large clots of adhering individuals break into smaller groups. Many of the separating components are seen to be united in pairs, by contact of their oral surfaces; others are again single, as at the beginning. The individuals that are united in pairs do not separate, but become closely adherent. They continue their union (conjugation) until complex processes have occurred in their nuclei, including repeated division and exchange of parts of the nuclei and chromosomes. This requires many hours; often in Paramecium bursaria the pairs remain united for 36 hours or more.[1]

In their obvious features the sexual reactions just described are like those seen in the minute Flagellata, and in most other Ciliata. But in the Flagellata the two individuals of a pair do not separate, but unite completely to form a zygote which later divides to produce new individuals. In all the Ciliata the two members of a pair separate after exchange of chromosomes, and each divides, producing many vegetative descendants.

In the Ciliata, such as Paramecium bursaria, the animals are large enough so that individuals can be followed separately and the details of behavior determined. The individuals of different sex types are not pulled together or attracted from a distance. After the sex types are mingled the animals continue to swim about in the same way as when all are of one sex type. The movements are no more rapid or "excited", nor modified in direction than when but one sex type is present. But the usual movements of many individuals in many directions in a small quantity of fluid soon bring some of them into accidental contact. It is then that the reaction occurs. The two that have come in contact, if they belong to different sex types, stick together as if their surfaces were covered with an adhesive material. There is no definite movement of reaction that brings about their contact. On the contrary, each of the two individuals is seen at first to try (as it were) to continue moving just as before, but upon contact both are suddenly stopped by their adhesion; or one drags the other backwards or obliquely, against the motion of its cilia. Only if the two anterior ends

[1]Photographs of various stages in the sexual behavior described have been published by Jennings, *American Naturalist*, Vol. 73, 1939, page 387; *Biological Symposia*, Vol 1, 1940, page 119 and *Genetics*, Vol. 24, 1939, page 204, also by Sonneborn in Calkins and Summers' *Protozoa in Biological Research*, 1941, page 691.

happen to lie in the same direction, as is rarely the case, do the two swim forward together. Any parts of the body that come in contact adhere. Two individuals may come in contact by their oral or aboral surfaces or by their rear ends, or in any irregular way; thereupon they adhere and consequently move irregularly, as a result of the uncoordinated action of the cilia of the two.

Two individuals thus adhering irregularly flounder about and may soon come in contact with other individuals of one or the other sex types. Such third individuals adhere irregularly to the original ones (always the adhesion is to the individual that is of different sex type from the new one); thus new individuals are continually added, till large masses or clots are formed, containing often a hundred individuals or more. In these clots the individuals are in irregular contact by any parts of their bodies, though always any two that adhere are of different sex types.

The large clots thus formed within three or four minutes after the mixture of the two sex types commonly remain seemingly unchanged for one to several hours, then begin to break up. In the meantime, by shiftings within the mass, some pairs of individuals have come into contact by their oral surfaces and these surfaces then become firmly united. Such pairs remain united until the complex nuclear changes and exchanges have occurred. After these are finished the two members of the pair (in the Ciliates) separate and each may continue its independent life, each having now a new combination of chromosomes formed from parts of the chromosome store of the two individuals that conjugated. In favorable cases each divides repeatedly, giving rise to a large number of individuals all having the same chromosome combinations and hence the same inherited characteristics. Such a group of individuals, derived by fission from the same ancestral ex-conjugant and all having the same characteristics, is known as a clone.

Thus the essential processes in the mating reaction (conjugation) are: (1) the normal active movements, bringing individuals of different sex type into accidental contact; (2) adhesion of those that are of different sex types, when they come in contact; (3) the gradual shifting of such individuals as are in irregular contact until some of them reach the normal mating position with oral surfaces united, axes parallel and anterior ends in the same direction; (4) more complete union of the oral surfaces; (5) internal changes, including division of nuclei and exchange of parts of them along with their contained chromosomes; (6) separation of the ex-conjugants and (7) their division into many individuals, forming a clone.

The account just given, based primarily on Paramecium bursaria, is

typical for mature stocks in other species of that genus. In Euplotes patella the conjugation occurs between two individuals without the antecedent formation of clots of many adhering individuals. In the flagellates, which are very minute, clots are formed like those in Paramecium, but the individuals of different mating types are said to be attracted together from a distance.

But many conditions alter the sexual behavior, or prevent the reactions entirely, rendering the behavior in a high degree discriminatory. Certain types of individuals react together in the way described, while others do not. The principal categories of conditions that alter the behavior are the following:

1. If all the individuals present are of the same sex type they do not react sexually at all; do not clot together, nor unite in pairs. (Rare exceptions to this have been described for certain species under special conditions; these are mentioned later).

2. Individuals of young clones, produced by the division of ex-conjugants (individuals that have just completed conjugation), are immature and do not react sexually at all; do not conjugate until they have reached a certain age.

3. If the individuals present belong to different varieties of the species, or to different species they do not react sexually, do not conjugate, whatever the sex types to which they belong.

Each of these three categories presents points of interest, some of which are set forth in later paragraphs But before proceeding with these, certain other kinds of social behavior must be mentioned: behavior which does not as a rule lead to conjugation. There are two of these other types of behavior.

1. One of these other types shows itself in association of pairs of individuals in coordinated motion, yet without adhesion and usually without leading to conjugation. Two individuals accidentally touch each other. They then move off in coordinated motion, side by side, at least the cilia in contact, but the bodies not adhering together. They swim thus in a graceful spiral for a few seconds, remaining in contact, then they may separate, or they may continue in contact, swimming together for a longer period. Often after thus moving together for a time they separate; then soon come together again, and this alternation may be repeated a number of times, until as a rule they finally separate and each goes its own way.

Yet if the two individuls are different sex types of the same variety the coordinated motion in contact may finally result in adhesion, union, and

completed conjugation. In some species of Ciliates indeed (Euplotes patella) this appears to be the usual or exclusive method of bringing about conjugation, for in such species the preliminary formation of clotted masses does not occur.

But such coordinated swimming together does not usually lead to conjugation, for it may occur in two individuals that are of the same mating type and hence do not conjugate. It may also occur in individuals that belong to different varieties, and in individuals one or both of which are immature. In all such cases conjugation does not result.

In this behavior discrimination of individuals is seen only in the fact that in some cases (where the individuals belong to different mating types of the same variety) adhesion and conjugation result, while in other cases they do not. Viewed as a whole, this type of behavior might be considered exploratory in functions: a process of finding appropriate mates.[2]

2. The second type of reaction between individuals that does not lead to conjugation is seen in the toxic or lethal reactions between individuals of certain varieties, described by Sonneborn in Paramecium aurelia. When individuals of one variety are brought into close proximity with those of a certain other, the individuals of one of the varieties are injured: they spin about on the long axis, swell, and soon die. "Two stocks produce toxic substances that kill animals of other stocks. The two toxic substances produce characteristically different effects prior to death, and each acts differently on the three groups of stocks of P. aurelia and on certain other species of Paramecium. These substances play an important role in natural selection, for, when a stock that produces a toxic substance and a susceptible stock are grown together the latter is soon completely killed off," (Sonneborn, *Science,* November 25, 1938, Vol. 88, p. 503).

Returning to the typical behavior that leads to conjugation, including preliminary adhesion into clots, the three different categories of modification and discrimination mentioned on a previous page show further matters of interest as follows:

1. Diversity of Sex Type—As before seen the completed sexual reactions occur as a rule only between members of different sex types of the same variety. The adhesion of surfaces which is a prominent feature of these reactions is a reciprocal matter; it does not occur unless the individuals are of different sex types. It is a result of the difference between the two surfaces.

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[2]Figures of this behavior have been published by Jennings, *Genetics,* Vol. 24, 1939, Figure 2, page 207.

Moewus has elucidated the nature of these differences in the flagellates. He finds that the two different sex types in Chlamydomonas are diverse in the possession of certain organic chemicals, or "sex-stuffs." These belong to the group of carotinoids. One of the sex types (which Moewus calls the female) has a sex-stuff that is a carotinoid known as cis-crocetin dimethylester, while in the other sex type ("male"), the sex-stuff is a modification of the same material, known as trans-crocetin dimethylester. By mixing these two in varied proportions, sex-stuffs characteristic of the different varieties in Chlamydomonas are produced. In the ciliates no such analysis of the sex-stuffs has been made.

In any variety of the flagellates, so far as examined, there are two sex types, so that the situation is analogous to that in the higher organisms, where there are two sexes. In the Ciliates a similar situation is found in Paramecium aurelia, and seemingly in Paramecium caudatum; there are just two sex types in any variety. But in certain other Ciliates there are, in a single variety, more than two sex types. In Euplotes patella there were found six diverse sex types in the stock examined by Kimball. In Paramecium bursaria one variety has eight sex types; two others have four sex types each, while in a fourth variety there are but two sex types. In those cases in which there are several sex types, members of any one sex type may conjugate with individuals of any other sex type of the variety.

Thus in Variety I of Paramecium bursaria there are four sex types, which have been designated A, B, C, and D. Individuals of the sex type A may react sexually with individuals of any of the other three sex types, so that pairs containing an individual of A may have the constitution AB or AC or AD. Similarly any individual of B, C, or D react sexually with any individual of the other three types. Thus from this variety with its four sex types there may be formed pairs of six different constitutions, namely, AB, AC, AD, BC, BD and CD. Variety II in this same species has eight different sex types designated respectively as E, F, G, H, J, K, L, M. Since members of any sex type may conjugate with members of any of the other seven, consideration shows that from the eight sex types pairs of 28 different constitutions may be formed, from EF to LM. In Variety III of Paramecium bursaria there are again four sex types, N, O, P, and Q; from these again pairs of 6 diverse constitutions may be formed. In Variety IV of the same species there are but two sex types, R and S, so that all pairs formed are of the same constitution, RS. Thus in the four varieties of Paramecium bursaria the number of pairs of diverse constitutions that may be formed is 6+28+6+1, or 41.

Any two sex types, as A and B, are distinguishable by the fact that either may conjugate with all other types of the variety but not with its own type. Thus A will conjugate with B, C and D, but not with others that are A; B will conjugate with A, C and D, but not with others that are B, and so on.

All members of the same clone (derived by fission from a single exconjugant), are found, on becoming mature, to belong to the same sex type. Thus in Variety I of Paramecium bursaria, some clones are all A, others are all B, others C, others D. This fact, that all members of a clone are alike in sex type (as well as in other genetic characteristics) makes it convenient to employ the clone as the unit in experimentation and in discourse. Clones may be mated with other clones of different sex type; a clone refuses to mate with other clones of its same sex type, and so on. The clone thus corresponds in many ways to the individual body of higher organisms. Both consist of many cells, though in the clone these cells are separate and may be scattered in space and time. Also the cells of the clone are usually all alike, while those of the body are functionally differentiated. But the clone as a unit is of a particular sex type, as the body is of a particular sex. Like the body, the clone is at first sexually immature; later it is mature; still later both as a rule become aged and finally die.

Thus any clone is of a definite sex type and when mature, it conjugates with a clone or clones of different sex type. But if no opportunity is given for conjugation with a clone of different sex type, the single clone differentiates into two diverse sex types, which thereupon conjugate together. In species in which there are but two sex types, the self-differentiation of a clone is of course into those two. In varieties which include more than two sex types, the differentiation of any clone produces always a particular pair of sex types. In Variety I of Paramecium bursaria some clones that are of sex types A differentiate into A and B; others into A and C, others into A and D. In Paramecium aurelia Sonneborn has shown that the self-differentiation of a clone into two sex types as a rule takes place as a result of certain nuclear processes, known as autogamy (at endomixis). But in a few cases it has been established that in this same species such self-differentiation into two sex types may occur during ordinary vegetative reproduction, without the occurrence of endomixis (Kimball). In some species, as in Paramecium bursaria, self-differentiation of a clone occurs very infrequently at seemingly irregular intervals of usually a year or more. In others, as in some varieties of Paramecium aurelia, it occurs at frequent intervals, of but about two to four weeks.

In consequence of the self-differentiation of the clone into two sex types, the members of a single clone may conjugate together, as if they belonged to two distinct clones. The two sex types into which a clone thus differentiates remain distinct; if they are cultivated separately the descendants of the two remain of the diverse sex types into which the clone had differentiated.

The conjugation that occurs within a self-differentiated clone thus still conforms to the rule that it is members of two diverse sex types that unite in conjugation. But there have been described a few cases in which under special conditions members of the same sex types unite sexually, though in most such cases conjugation is not completed. Moewus observed in a species of Chlamydomonas such incomplete conjugation between members of the same sex type. In this species, from a dense culture in which all are of one sex type the individuals (cells) are removed by centrifuging or filtration, leaving only the fluid. If now individuals of the other sex type are treated with this filtered fluid, they are induced to clot together, just as occurs when individuals of both sex types are present. But there is no final complete union of the individuals, such as occurs when the two are of different sex type; soon they separate.

Similarly Sonneborn found that when individuals of Paramecium aurelia belonging to two sex types are mixed, for a short time some individuals that are of the same type clot together, though in these cases as in those described by Moewus, completed conjugation does not occur between individuals of the same sex type.

In Euplotes patella, however, Kimball found that in mixtures of two sex types, at times completed conjugation occurs between what were at the beginning members of the same sex type. It is possible that a temporary change in sex type had occurred though this appears improbable. The change could be only temporary, since in such cases when the two individuals that are in the preliminary stages of conjugation are cultivated separately, the two give rise to clones that are still of the same original sex type (Kimball).

Conditions parallel to those just set forth for Paramecium aurelia and Euplotes patella have recently been discovered by T. T. Chen in Paramecium bursaria. Studies of these phenomena will be published by Chen.

Thus in most cases conjugation occurs only between members of different sex types. But previous contact with members of a different sex type, or with fluid in which these have lived, may induce a temporary clinging together of members of the same sex type, or in some cases may induce completed conjugation.

We have seen in previous paragraphs that change of sex type may occur at self-differentiation of a clone, through endomixis or otherwise. Changes of sex type occur also as a result of conjugation. The two members of a conjugating pair are of course (at least as a rule) of different sex type; each one when it multiplies without conjugation produces a clone of its own distinctive sex type. As a result of conjugation one or both may change in sex type, so as to yield after conjugation descendants that are of different sex type from those produced before conjugation. In Paramecium aurelia, in which but two sex types exist in any variety, the two ex-conjugants of a pair may both yield clones of sex type I, or both may yield clones of sex type II, or one may yield sex type I, the other sex type II. In Paramecium bursaria both ex-conjugants of any pair as a rule produce clones of the same sex type. But different pairs from the conjugation of the same two clones yield in many cases, different sex types. For example, in Variety I with its four sex types, A, B, C and D, if many individuals of a clone of sex type A conjugate with members of a clone of sex type D, some of the pairs (which are originally all AD) produce descendants that are all of sex type A, others, descendants that are all of sex type D, while a few pairs produce descendants that are of sex type B, a few others, descendants that are of sex type C. The general rule in this species is that most of the pairs produce descendants that are in sex type the same as one or other of the two clones that conjugated, while a few yield descendants of different sex type from either parental conjugant. From conjugants of but two of the four types may be produced descendants that are of three or of all the four types that exist.

2. Immaturity and Maturity—The reaction between individuals is determined or modified not only by differences in sex type, as set forth above, but by differences in age of clones. After conjugation, in the Ciliates the two ex-conjugants separate and each divides vegetatively many times, so as to produce a large number of separate individuals, constituting a clone. Usually for some period, short or long, all the individuals of the young clones are sexually immature; they do not react sexually nor conjugate with any other members of the variety, whether mature or not, and whatever their sex type. The immature individuals do not differ visibly from mature ones except in this absence of sex reaction and of conjugation. The length of the period of sexual immaturity differs much in different species and even among clones of the same variety of the same species. In Paramecium bursaria the period of immaturity is usually long; observed immature periods have varied in different cases from twelve days to many

months. In Paramecium aurelia the immature period is short or non-existent; it varies in different cases from zero to a week or ten days. In Paramecium bursaria it has been found that the length of the immature period depends to some extent on the nutritive conditions under which the individuals lived. Those that have been kept well-fed and in rapid multiplication become mature much earlier than members of the same ex-conjugant clone that have been subjected to unfavorable conditions such as reduce the rate of multiplication.

During the immature condition individuals may react to each other by the coordinated swimming in contact that was previously described, but they do not adhere together and do not conjugate. As maturity approaches some of the individuals of the clone begin to show a weak tendency to adhere when they touch. This period might be called adolescence; it may last for weeks and include many generations. The tendency toward conjugation becomes stronger, till in time the individuals show the strong and spectacular mating behavior that was before described. The new clone is now mature. It is not till maturity is reached that it is possible to discover to what sex type the clone belongs.

3. Non-interbreeding Groups or Varieties—The complexity of the social life in the Protozoa is greatly increased by the fact that given species have not only diverse sex types, which conjugate together, but include also, in cases adequately studied, groups of individuals that do not intercross, but remain sexually and genetically isolated. Each such group has its own set of sex types which conjugate together, but members of one group do not conjugate with members of other groups. Since members of such different groups do not intercross, the groups may be called varieties, though they may not be distinguishable by other characteristics.

In Paramecium aurelia Sonneborn has discovered seven groups or varieties. Each variety has two sex types which unite in conjugation (in one of the varieties at last account only one of the sex types had yet been found). Since the sex types of the different varieties do not conjugate together, but each conjugates with the other sex type of its own variety, there must be at least 13 or 14 diversely reacting sex types in this species, with correspondingly 13 or 14 diverse sex-stuffs.

In Paramecium bursaria five different non-interbreeding groups or varieties have been found. Group or Variety I has four diverse sex types, which have been designated A, B, C and D; Group or Variety II has eight sex types, E, F, G, H, J, K, L and M; Group or Variety III has the four sex types, N, O, P and Q, while Group or Variety IV has but the two sex

types, R and S. There are indications that one or two more varieties exist in this species, but these have not been fully studied. Thus in the four well-known groups or varieties of Paramecium bursaria there are 18 diverse sex types, and correlatively there must be 18 diverse sex-stuffs.

Fertile conjugations occur only between individuals of different sex types belonging to the same group or variety. Yet a few cases are known of abortive conjugations between members of different varieties. De Garis in 1935 induced by ingenious methods conjugation between individuals of Paramecium aurelia and Paramecium caudatum, but both members of all pairs died without producing descendants. Sonneborn in 1939 showed that a weak and partial sexual reaction occurs between certain mating types of two different varieties (Variety 1 and Variety 3) of Paramecium aurelia, but conjugation is never completed and no hybrid offspring result. In Paramecium bursaria conjugation may occur between one of the two sex types of Variety IV and any one of four of the eight sex types of Variety II, but the conjugants always die without producing descendants.

In such abortive conjugations between members of different varieties or species, it appears that the sex-stuffs of the two must have an affinity for each other, but the stocks have become so diverse in other respects that successful or fertile conjugation cannot occur.

What is the relation of the, in some instances, numerous "sex types" of Protozoa to the two sexes of higher organisms? The two types that are present in the flagellates have been by Hartmann and Moewus regarded as identical with male and female sexes, and as illustrating the supposed universal differentiation of living material into male and female. The cases in which there are four, six or eight "sex types," as in Paramecium bursaria and Euplotes patella, obviously present difficulties for this point of view. In order not to prejudge the question and while waiting for more evidence to accumulate, the diverse "sex types" of the Protozoa are commonly spoken of by the non-committal term "mating types." Since, however, the differentiations into types in the Protozoa is at least analogous to the differentiation of sexes, it seems appropriate to bring out this analogy by the use of the term "sex types"; hence this term is employed here. For the rest, one must wait for further evidence.

In any case the differentiation into sex types and "varieties" and the change in behavior with change in age result in a social system that is complex. In a population of a given species there occur individuals showing many different kinds of behavior. There are young, immature individuals that do not react sexually; there are adolescents in various grades of develop-

ment; there are mature individuals. Among any of these may be represented any or all of the varieties and sex types that occur in the species; in Paramecium bursaria, for example any of the eighteen known sex types, distributed into four non-interbreeding varieties. An individual that meets with these various kinds of other individuals varies its behavior in accordance with the place they occupy in the system. If they are of the same sex type as itself, whether young or mature, or if young and immature whatever their variety or type, or if they belong to a different "variety" of the species, there may be no reaction at all; or the two individuals that meet may swim for a time in contact, in coordinated motion, though after a time they separate. If the individual met belongs to the same variety but to a different sex type, there is another kind of behavior; the two adhere together and conjugation occurs. Among the 18 diverse sex types of Paramecium bursaria, any individual of Variety I or Variety III will react sexually with three, but refuse to react with the other 15; an individual of Variety II will react with seven and reject eleven; while, an individual of Variety IV will react fully with but one, partially with four others, and reject completely thirteen.

For more detailed knowledge of the organisms and relations described above the publications mentioned in the appended list may be consulted.

Publications summarizing knowledge on the matters discussed on the foregoing paper:

Sonneborn, T. M., "Sexuality in Unicellular Organisms," Chapter XIV, in Calkins and Summers' *Protozoa in Biological Research,* 1941.

Kimball, R. F., "Mating Types in the Ciliate Protozoa." *Quarterly Review of Biology,* Vol. 18, pages 30-45, 1943.

Jennings, H. S., "The Beginnings of Social Behavior in Unicellular Organisms," *Leidy Memorial Lecture,* University of Pennsylvania Press, 1941.

SOCIAL BIOLOGY OF SUBHUMAN GROUPS[1]

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Interest in the social impact of science in general and of biology in particular has been growing steadily in the last few decades. The problems imposed by the present war and by thoughts of the coming post-war world have increased this interest. My own active concern with various phases of the sub-social and social life of non-human animals has revealed enough of the complexities of these simpler social systems to make me well aware of my limitations when confronted with the modern social problems of men. It is the drive of immediate necessity rather than a feeling of competence that impels me to undertake the present discussion of the biological foundations for some fundamental phases of the social behavior of men.

I. The Biological Evidence

In our laboratory we are making two experimental approaches to the phenomena of biological sociology, and each yields its very different aspect of truth. On the one hand, we have been studying for over a decade the dominance-subordination relations that are characteristic of many social groups. We know from personal observations, as well as from the literature, of nip-orders in fish, peck-orders in flocks of several species of birds and fighting orders in mice. Usually there is one dominant animal which can bite, nip or peck others without being attacked in return. Below it the others are ranked in various degrees of subservience. Similar dominance orders occur among such mammals as rats, cats, cows and men. Social organizations have also been reported with certainty for turtles and for lizards, as well as for many species of birds and mammals besides those which we have observed.

These social organizations are based immediately on fighting or bluffing ability, on individual aggressiveness or meekness, as exhibited in pair contacts between the different members of the vertebrate group in question. Usually the complete social order within a small group is determined during the first few days of contacts; often, among hens, for example, in the first series of encounters. The order, once established, is not readily upset. With certain fish, until the group is well established, changes occur fairly fre-

[1]A slightly reworded reprint of the first section of "Where angels fear to tread: a contribution from general sociology to human ethics," *Science*, 97: 517-525, 1943.

quently; but with hens, we have observed the same peck order to persist unchanged for as long as a year, and this is a relatively long time in the life of a hen. These social orders are a real expression of crude, person-against-person competition for social status and furnish fair illustrations of the individualistic, egocentric phase of group biology. Here is an aspect of the individual struggle for existence, and as such it illustrates an important phase of the Darwinian theory of evolution.

High position in the social peck order confers privileges. We know that top-ranking animals feed more freely; that high-ranking males of rhesus monkeys, sage grouse and the common domestic fowl have more ready access to females. Low social status may lead to semi-starvation, to psychological castration among cocks, to ejection from coveys of quail; and among many species it forces the low birds into inferior territories. In some cases, high social rank carries responsibilities for leadership or for guard duty; in other instances no correlation with social duties has been demonstrated as yet. Among others, I have published research reports and discussions of many such relationships and need not dwell on them longer.

These studies of individual aggressiveness make one experimental approach to general and comparative sociology. Our second line of attack comes from a different quarter. For more than twenty-five years we have been experimenting with group-centered tendencies which long before my time were called cooperation. Careful students nowadays point out that, among lower organisms, cooperation is entirely non-conscious. In this phase of our study we are investigating natural cooperation somewhat as many other biologists have been concerned with natural selection. Natural cooperation in its simpler forms implies merely that the interrelations between cells, for example, are more beneficial than harmful for the individual, or that the interrelations between individuals are more beneficial than harmful for the given social group.

I have added to and reviewed repeatedly the modern evidence concerning the existence of such cooperation. Mere repetition does not necessarily make for acceptance, but a good purpose may be served by summarizing in outline form the types of modern evidence that I have found compelling; the details can be filled in from the extensive literature.[2]

(1) At all levels of the animal kingdom, and under a variety of conditions, there is added safety in numbers up to a given point. Animals from the protozoans to insects or man meet many adverse conditions better if

[2]W. C. Allee, "The Social Life of Animals," 283 pp. New York: Norton, 1938.

optimal numbers are present rather than too few. There is danger also in overcrowding, but I am emphasizing just now the danger of the population being too sparse. For certain animals this sort of mass protection exists when the organisms are exposed to heat. Mass protection from cold is more common, as is protection from many poisons and from other harmful chemicals. Optimal numbers also protect from ultra-violet radiation, from radical changes in osmotic pressure and from many environmental deficiencies.

Macerated cells of a sponge will not regenerate if too few are present and the smallest embryonic grafts frequently fail to grow when somewhat larger ones succeed. If a natural population falls too low, it is in danger of dying out even though theoretically able to persist.

(2) In keeping with the relations just outlined, many organisms, both plants and animals, are able so to condition an unfavorable medium that others following or associated with them can survive better and thrive when they could not do so in a raw, unconditioned medium.

(3) Certain vital processes are adaptively retarded by increased numbers up to a given density. For example, scattered spermatozoa of many marine organisms lose fertilizing power more rapidly than they do when they are massed together.

(4) Other biological processes are accelerated, perhaps beneficially, in the presence of populations of optimal size and density. Such processes are slowed down both in over-sparse populations and in those that are overcrowded. Cleavage rate in Arbacia and certain other eggs follows this rule. Various kinds of Protozoa show acceleration in rate of asexual reproduction with medium rather than sparse population density, and similar phenomena may well have been a forerunner of

(5) The evolution of the cooperative processes which are associated with sexual reproduction.

(6) Colonial protozoa could hardly have evolved from solitary forms unless the simple colony of cells that remained attached after divisions had shown cooperative powers that were lacking when the cells were scattered singly. The evolution of the Metazoa from the Protozoa was probably based on similar relationships.

(7) Each advance in complexity of metazoan individuals came from the natural selection of an increased ability in natural cooperation on the part of the evolving stock; the greater natural cooperation came first, and then it was selected.

(8) Darwin[3] recognized that a relatively large population is a highly

[3]"Origin of Species," Murray's Library Edition, p. 74.

important factor in natural selection. Sewall Wright and others have evidence that evolution proceeds most rapidly in populations of interbreeding organisms that are intermediate in size, as compared with similar populations which are over-small or over-large.

(9) The interdependence of organisms is shown by the repeated observation that all living things, from the simplest to the most complex, live in ecological communities; this is plainly seen in the many biocoenoses, such as those of the oyster bed. Further, the evolution of truly social animals has occurred independently in widely separated divisions of the animal kingdom. These could hardly have arisen so frequently and from such diverse sources if a strong substratum of generalized natural cooperation were not widespread among animals in nature. In nature, no animal is solitary throughout its life history.

(10) As with the individual organisms, each advance in complexity of the social life of any group of animals is based on the development of some means of closer cooperation between the individual units of the evolving group.

We have good evidence then that there are these two types of social or sub-social interactions among animals: the self-centered, egoistic drives which lead to personal advancement and self-preservation, and the group-centered, more-or-less altruistic drives that lead to the preservation of the group or of some members of it perhaps at the sacrifice of many others. The existence of egoistic forces in animal life has long been recognized. It is not so well known that the idea of the group-centered forces of natural cooperation also has a respectable history. I take time to give a bare outline of the growth of this idea and to mention some of its proponents because many professional and lay students are interested in the men who have accepted an idea as valid as well as in the evidence that supports it.

The germ of the concept of natural cooperation, along with that of natural selection, can be traced to the biologically absurd poetry of Empedocles about the middle of the fifth century, B.C. Thereafter the principle was kept feebly alive by the succession of thinkers from Aristotle to Herbert Spencer and beyond, who saw human society as a natural outgrowth rather than as an artifact.

More positive emphasis on the "altruistic" interpretation began with the third Earl of Shaftesbury who, about 1700, recognized clearly that racial drives exist which can be explained only by their advantages to the group. He thought that there is a natural goodness about men and recognized that other animals may be kind to associates of their own species. Adam Smith,

in his "Theory of Moral Sentiments," wrote in 1759 of the same qualities under the heading of "sympathy" or "fellow feeling." His more famous "Inquiry into the Wealth of Nations" (1776) is based on the opposed forces of self-interest and he did not publicly reconcile the two. Later Comte (1798-1857) emphasized "altruism" as Feuerbach (1804-1872) did "love." These relationships are reviewed sympathetically by Lange (1865) in his remarkable "History of Materialism."

Herbert Spencer argued now for egoism and again for altruism. In 1901 he balanced the two in the following quotation from his "Principles of Ethics": If we define altruism as being all action, which in the normal course of things, benefits others instead of benefiting self, then, from the dawn of life, altruism has been no less essential than egoism. Though primarily it is dependent on egoism, yet secondarily egoism is dependent on it."

Darwin, in the "Origin of Species" (p. 215) recognized that evolution within the worker caste of ants can be explained by remembering that selection can act on the family as well as on the individual and Weismann[4] in 1893 underscored the point. Such ideas are in keeping with Darwin's use of the phrase "struggle for existence," of which he said: (p. 46) "I use this term in a large and metaphorical sense including dependence of one being on another and including (which is more important) not only the life of the individual, but success in leaving progeny."

In the "Descent of Man" (1874), Darwin gave Kropotkin-like naturalistic examples of mutual aid; and we can readily see that Darwin's whole thesis that man is descended from other animals requires that man's altruistic drives have precursors among his animal ancestors. Darwin clearly derives the moral sensibility of man from his "social instinct" played upon by reflective intelligence and states (p. 122): "The term, general good, may be defined as the rearing of the greatest number of individuals, in full vigour and health, with all their faculties perfect, under the conditions to which they are subjected. As the social instincts both of man and the lower animals have no doubt been developed by nearly the same steps, it would be advisable, if found practicable, to use the same definition in both cases, and to take as the standard of morality, the general good or welfare of the community. . . ." He recognized group-focused tendencies in the higher mammals. He did not, as nearly as I can judge, sense the existence of the reservoir of sub-social and social tendencies of which Espinas[5] wrote in 1878.

Geddes and Thompson comment in their book called simply "Evolution"

[4]August Weismann, *Contemp. Rev.*, 64: 309-338, 1893.

[5]A. V. Espinas, "Des sociétés animales," 588 pp., Paris, Libraire Ballière.

(p 167), which was published in 1911, that "Darwin's characteristic fundamental idea of the intricacies of the interrelations in the web of life lies below the idea of natural selection." Later, in speaking of family and group selection they continue: "Though Darwin did not wholly overlook this (indeed in one notable passage he expresses it) there is no doubt that the general tone and treatment of Darwinism even hitherto has been colored by the acute individualism of Darwin's and the preceding age."

Evidence that the egoistic emphasis was common in British scientific circles during Darwin's later life and that group-centered interpretations were novel is found in a news note from *Nature* for January 21, 1880: "We notice an important communication by Prof. Kessler at the annual meeting of the St. Petersburg Society of Naturalists on January 8 [1880] on the 'Law of Mutual Help' as one of the chief agents in the development and progress of organisms. Prof. Kessler, although an able follower of Darwinism, thinks that the struggle for existence would be insufficient to explain progress in organic life, if another law, that of sociability and mutual help, did not powerfully work for the improvement of the organism and for strengthening the species."

Espinas (1878), two years before Kessler's lecture, had given a similar interpretation which he supported by the best observations then available. Espinas emphasized the naturalness of the cooperative, social drives. Geddes and Thompson reaffirmed a similar conclusion in 1911: "We may therefore restate the concluding thesis of our 'Evolution of Sex' (1889) since elaborated in various ways by Drummond, by Kropotkin and others. It is that the general progress both of the animal and plant world, and notably the great uplifts, must be viewed not simply as individual but very largely in terms of sex and parenthood of family and association; and hence of gregarious flocks and herds of cooperative packs of evolving tribes and thus ultimately of civilized societies. . . ."

The idea did not catch general scientific attention despite the emphasis placed on such an interpretation by Delage and Goldsmith (1912),[6] Rein-

[6]Y. Delage and M. Goldsmith, "The Theories of Evolution," 352 pp. London: Palmer, 1912. H. Reinheimer, "Evolution by Cooperation; a Study in Bioeconomics," 200 pp. London: Paul, Trench, Trübner and Co., Lt., 1913. H. Reinheimer, "Symbiosis, a Socio-Physiological Study of Evolution," 295 pp. London: Headley Brothers, 1920. W. Patten, "The Grand Strategy of Evolution," 429 pp. Boston: Badger, 1920. W. M. Wheeler, "Social Life among Insects," 375 pp. New York: Harcourt Brace, 1923. W. M. Wheeler, "Social Evolution." Chapter IV in "Human Biology and Racial Welfare," 612 pp., E. V. Cowdry, ed. New York: Hoeber, 1930. Guyer, M. F., "Animal Biology," 3d ed., 723 pp. New York: Harpers, 1941. "Speaking of Man," 321 pp.

heimer (1913, 1920), and William Patten, who in 1920 made the cooperative principle the central point in his "grand strategy of evolution." The neglect continues despite the repeated emphasis given by William Morton Wheeler (1923, 1930), despite my own summaries of supporting evidence and the more recent adoption of this point of view by Guyer (1941, 1942), Emerson (1942), Gerard (1942) and others whose opinions should carry weight. Today, as in Darwin's time, the average biologist apparently still thinks of a natural selection which acts primarily on egoistic principles, and intelligent fellow thinkers in other disciplines, together with the much-cited man-in-the-street, cannot be blamed for taking the same point of view. Personally, I was well and thoroughly trained in this orthodox biological doctrine. For example, it was clearly stated in the first chapter of a book published in 1913 by my stimulating friend and former teacher, Professor V. E. Shelford.[7]

As was shown earlier, both egoistic and group-centered forces exist in nature and both have been brought under experimentation. I had wondered for years whether we could experimentally test for possible relationships between these two basic phases of animal behavior. Might organized groups of birds, to take one possible instance, have survival values for the group in general as a result of their organization, even though there were no signs of an organized group defense? It will be remembered that such a group organization is based on individual aggressiveness and yields survival values for the high-ranking individuals in the peck order.

I have not yet been able to devise an elegant experiment to test the point. The best one I have yet devised was carried through carefully and ran for over a year. Briefly, three flocks of line-bred hens were allowed to become organized and are kept as controls. In a similarly housed neighboring flock of the same stock, a new hen was added daily or every second day and the hen which had been longest with the flock was removed and placed in isolation for twenty-one days or more before she was again introduced into the experimental flock. By that time, apparently, she had forgotten all other hens as individuals; hence the experimental flock was in a state of continual reorganization.

I cannot take time for details and without them you will be unable

New York: Harpers. A. E. Emerson, "Basic Comparisons of Human and Insect Societies," Biol. Symposia VIII, 163-177, 1942. R. Gerard, "Higher Levels of Integration," Biol. Symposia, VIII, 67-87, 1942.

[7]V. E. Shelford, "Animal Communities of Temperate America," 362 pp., Univ. of Chicago Press, 1913.

to make critical judgment concerning the value of the experiment.[8] An individual can effect the quality of the group life in these flocks; still, despite differences in individuals, the indications are that regardless of the individuals that may be present the organized flocks eat more, maintain weight better and spend less energy in fighting, bluffing and pecking each other and lay more eggs than is the case with the flock that is daily subjected to reorganization. The strong suggestion is that an organized flock of hens has survival value as a flock which is lacking among an otherwise wholly similar group of hens, that is never allowed to become socially stabilized.

With all its imperfections, the experiment suggests that person-to-person competition, if not too severe, may lead to group organization which increases the effectiveness of the group as a cooperating social unit in competition or cooperation with other social organizations. Such a conclusion had been suggested by naturalistic evidence. Other data, certain types of which have already been summarized, indicate that cooperation at the individual level may also yield groups with increased competence in competition or cooperation at the group level. Any group organization, however achieved may be helpful under many conditions. There is suggestive evidence that the relations between individuals which form a simple group of the first order are repeated between such groups when compounded into a unit of a higher social order. Even when society becomes still more complex, the relationshps remain essentially similar. Throughout the higher social categories, there may be group-centered egoism and tendencies toward inter-group cooperation at one and the same time.

With cosmopolitan species, whether of human or of non-human animals, in last analysis, the cooperative units tend towards being world-wide in scope. If in its spread over the globe the common house sparrow becomes a new host for a virulent disease organism, the welfare of the whole species may be affected. Sessile eel grass has been devastated on the Atlantic coasts of Europe and of North America by the same mycetazoan parasite. The conclusions that I have been discussing are based primarily on objective studies with non-human animals. They are supported by much evidence from the interrelations of men; and the global scope of the cooperative interests of *Homo sapiens* are more obvious and have more possibilities for development than have those of any other species.

The picture that emerges from the cumulative studies on social biology is one in which cooperations and their opposite, disoperations, both exist.

[8] A. M. Guhl and W. C. Allee, "Some measurable effects of social organization in flocks of hens," *Physiol. Zool.*, 17: 320-347, 1944.

There are both egoistic and altruistic forces in nature, and both are important. The question arises insistently as to which of these is more fundamental and potent. Any such evaluation must be based on both short-run and long-run effects. After much consideration, it is my mature conclusion, contrary to Herbert Spencer, that the cooperative forces are biologically the more important and vital. The balance between the cooperative, altruistic tendencies and those which are disoperative and egoistic is relatively close. Under many conditions, the cooperative forces lose. In the long run, however, the group-centered, more altruistic drives are slightly stronger.

If cooperation had not been the stronger force, the more complicated animals, whether arthropods or vertebrates, could not have evolved from the simpler ones, and there would have been no men to worry each other with their distressing and biologically foolish wars. While I know of no laboratory experiments that make a direct test of this problem, I have come to this conclusion by studying the implications of many experiments which bear on both sides of the problem and from considering the trends of organic evolution in nature. Despite many known appearances to the contrary, human altruistic drives are as firmly based on an animal ancestry as is man himself. Our tendencies toward goodness, such as they are, are as innate as our tendencies toward intelligence; we could do well with more of both.

GENE DETERMINED PHYSICAL MODIFICATIONS AFFECTING THE SOCIOMETRY OF RATS

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Any explanation of individual variations in the social behavior of a mammalian species must include reference to some of the characteristics that Darwin found to distinguish wild members of a species from its tame derivatives. The following quotations will be worth our consideration in this respect:

"Complete subjugation generally depends on an animal *being social in its habits* and on receiving man as the chief of the herd or family."

"With extremely few exceptions, all animals and plants which have been long domesticated *have varied greatly*."

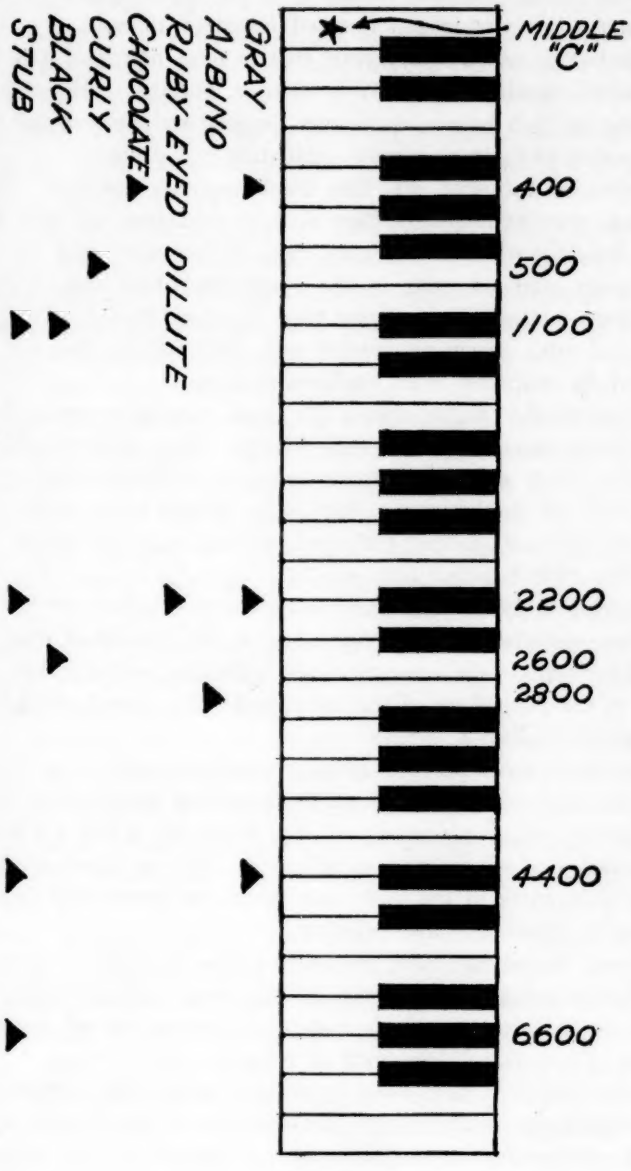
"It is notorious how greatly the *mental disposition, tastes, habits, consensual movements, loquacity or silence, and tone of voice have varied* and been inherited in our domesticated animals."

Among the reasons assigned by Darwin to account for these differences were good food and little exercise which he believed to have caused the domestic rabbit to have more than doubled the weight of the wild rabbit.

Other Darwinian alterations in the rabbit are indicated by the quotation: "The skull has increased in length but not in due proportion to the increased length of body."—"The brain has not duly increased in dimensions relative to the increase in body size or else has actually decreased."

One has only to attend a Dog Show in order to find ample evidence to prove that breeds inherit "behavior trends" with reference to particular situations. That is, individuals of two contrasted breeds tend to solve the same problem or situation in different but characteristic fashions, which behavior patterns are inherited somehow in the breed. For example, a Pointer sees a rabbit and "freezes" in silence, but a Foxhound goes after the rabbit, barking the while. A German Shepherd and a Boxer each meet an intruder. The Shepherd barks violently and flies at the man's throat. The Boxer silently topples the man over with great force and his front feet, and keeps him there quietly.

Terriers just cannot help digging, and Dalmatians that never saw a coaching performance have broken their leashes to run happily under a passing wagon. Other breeds show special tricks or talents, but little has been done toward measuring the results of these tendencies when applied to social behavior in the presence of their fellows. In a dog there is just too


GRAY
ALBINO
RUBY-EYED DILUTE
CHOCOLATE
CURLY
BLACK
STUB
MIDDLE "C"
400
500
1100
2200
2600
2800
4400
6600

much action, personality, and too many modes of expression to be able to measure social behavior in any detailed fashion with ease.

A questioning of fanciers reveals that in most breeds of dogs the pups may be raised together with relative security, but that anti-social behavior is so strong in such breeds as Boston Terriers and Dobermans that they must be separated early to prevent mutilation and death.

Breeders of raccoons say that black mutants not only tame more readily and more permanently than do gray raccoons, but also that they are more friendly with their fellows, fighting less often and less savagely than do grays, and returning to the woods less often when given opportunity. There is also some evidence that pink-eyed buff field mice, ground squirrels and mink are more amiable with their fellows than are the gray varieties of these species when confined to cages.

The personnel of racing stables tell of the superior stamina of Dun and Chestnut horses in contests with their fellows. They say that a Black horse seldom wins. They account for these trends by believing that it is a matter of "heart" by which they mean that (other things being equal) Dun and Chestnut horses retain longest their "will to win" and that Blacks lose most quickly their "will to win."

It appears probable that such variations in behavior are the result of mutant-gene variation in the inheritance of the individual that produces structural variation in the anatomy of the individual, which in turn produces variation in the physiology of the individual. The altered physiology must produce altered behavior.

It has been customary to assign these breed differences in behavior trend to the sum-total of modifications in general morphology, gland, and nervous system, which is undoubtedly the truth, but it has not been generally conceded that single-gene substitutions such as those producing the coat color differences of the fancy can determine measurable trends in, or syndromes of, personality and behavior.

However, Keeler and King published character sketches of the idiosyncratic behavior exhibited by strains of rats presumably differing from the wild Gray Norway in but a single coat color gene and reared under identical conditions. Their descriptions were as follows:

Mutant Albino. Cringe when approached after being completely tamed, When tamed, about as apt as the tamed Grays to bite or fight back when picked up. When not tamed, as wild and vicious as the Grays. When dropped on the floor they attack the caretakers as Grays do. It may be added that instead of running to the attack, they usually advance by a

series of bounds. Voice may be a high, sustained whistle having fundamental tone at a frequency of 2800 cycles per second and having no overtones, whereas the rough, loud Gray voice may have a fundamental at 400 with overtones at 220 and 4400.

Ruby-Eyed Dilute. Known to be fairly sluggish, but was not available for study on the original Gray background. Voice a high sustained tone with a frequency of 2200.

Cinnamon. (Chocolate pigment) Easier to tame than Grays, but may revert to the wild nature after being tamed. Vigorous and active. Ordinarily more peaceful than Grays, but when called on to fight, they fight quite as well as Grays. Rough, loud voice similar to that of the Gray Norway with a fundamental frequency at 400.

Curly. Even after being tamed difficult to catch, but when removed from the cage and held in the hand, they ordinarily do not bite. They can never be completely trusted. Voice: low, unsustained, with many varying components. Fundamental frequency is about 500.

Black. Sluggish. Already tame by nature. If very excited they may click their teeth, but are not apt to bite. Many only whine softly when picked up with tongs. Voice may be a high, sustained tone with fundamental at 1100.

Albino-Waltzer. Easier to tame than mutant Albinos from which they were derived but always nervous. When tamed, they seldom turn on the observer. Voice not tested.

Stub. Dwarfed, frequently tailless. Always fighting each other. Go out of their way to pick trouble. Do not mind their own business as do gray rats, but throw their bodies against the cage wire when anyone approaches. Voice is a high squeak with great amplitude at high frequencies. The fundamental is at 1100. Both 2200 and 4400 predominate with the peak at 6600.

Piebald. As wild as Gray. Not available on the original gray background. Voice not tested.

These behavior differences were recorded with reference to their handling by man, but they show distinct alterations in temperament and in abilities that are involved in dealing with their fellows. The modifications of response discovered in these studies show us what to look for in their interpersonal relationships. The physical modifications of these rats that are correlated with their altered behavior will apprize us of what sorts of physical modifications are important as determiners of observable variations in the interpersonal relationships of rats in particular. And for any other

species of mammals these physical characteristics play a similar role in determining behavior trends.

Body Size

Ordinarily among rats, the largest and strongest male in the cage rules his fellows with violence and, whether or not they fight back, the lesser males usually have their pelts covered with bites. The females ordinarily do not challenge the authority of the "big brute", but, nevertheless, he may give them an occasional nip just to keep them "thinking right".

Among rats there is a strong sense of possession that develops the individual morale, and a lesser male that has had a cage of his own will fight like a demon to defend it if the "big brute" is inserted into his cage. The sense of possession is also found in females, and in some cases it is dangerous to the life of the "big brute" male who apparently recognizes this right of ownership, because he seldom fights back with his usual savageness when placed in a strange cage that is being defended by either a lesser male or a female claimant.

Accordingly, I have seen seven males that were castrated or killed outright consecutively by a virago that resented their intrusion into her cage.

On one occasion a female, living alone, violently attacked a certain male every time that he was put into her cage. She was shifted to a new cage, but this did not reduce her antagonism appreciably. As a last resort, the male was etherized and placed in her cage "dead drunk". The female appeared bewildered by his unusual odor and staggering movements, and she made no attempt to attack him. On the contrary, when he gradually "came to" she accepted him fully as her cagemate and consort.

In all such contests body size plays a highly important role, other things being equal. It is now well known that some coat color genes make for larger and some for smaller bodies than the average.

Some coat color variations such as Chocolate pigment and Curly coat produce a greater length than normal, correlated with a corresponding increase in weight. Other genes, such as Hooded, Albino and Ruby-Eyed Dilute, decrease correspondingly both in length and weight. The Waltzing gene decreases length, but does not change weight, thus altering the bodily proportions completely. In two-gene combinations the effects of the genes are additive, observing the plus and minus signs. That is, the possession of two genes each inducing greater than average size will produce an animal still larger than if it possessed but one of these size-increasing mutant loci. Likewise, the possession of two gene mutations, each inducing smaller than

average size will produce an animal still smaller than if it possessed but one of these size-reducing mutant loci. And lastly, an individual, having received a growth increasing gene and a growth reducing gene, will be of average size, the two contrary tendencies having cancelled each other out.

Various coat color genes lengthen the tail slightly, and probably make it much thinner than normal, which modification would be a distinct disadvantage as a support in fighting.

General Physiology

In all of their bodily processes, it appears probable that most mutants are physiologically older than wild Gray rats of the same chronological age. That is, mutants in general seem to spin through their life processes at a faster rate than do wild Grays. If this be true, this fact might seem to throw a small advantage to the mutants during early months, but when the wild Gray rat is in its prime, a mutant of equal chronological age will have started to decline, and this fact should be and is detectable in such a general character as loss of water content in bones and tissues and possibly in a corresponding reduction in general strength. The relative rates of natural drying for different parts of the body will normally follow an axial gradient, the form of which is altered in some mutants, and the altered axial gradient, we may suppose, will have a slight effect on the bodily distribution of strength in an individual.

Acuity of Vision

Such coat color variations as Pink-Eyed Dilute, Red-Eyed Dilute, Ruby-Eyed Dilute or any other genetic entity that reduces or increases interocular pigmentation, of necessity put the bearer at a disadvantage in interpreting his surroundings, including the actions of his fellows and, accordingly, he is likely to be less certain of himself and less on his guard. The flashing of images vividly upon the Albino retina, for example, may actually keep an individual in a constant state of bewilderment.

Hearing

Although we do not have measurements of the dulling effects of mutant coat color genes upon auditory response, we may be certain that such exist and are of measurable size, because rats bearing coat color mutations are less sensitive to high-pitched sounds than are wild Gray rats maintained in the same laboratory.

Olfactory Sense

Important as eyes and ears may be in evaluating the environment, they are of not nearly so great importance as is the sense of smell in rats. Correspondingly, the deficiency variations in the olfactory sense will be of much greater importance to interpersonal behavior. It is the sense of smell that keeps the wild Gray rat most alert for danger and for the challenges of his fellow rats or other enemies. If both wild Grays and mutants are kept in the same laboratory the Grays immediately sense the presence of a human stranger as much as 40 feet away, whereas the mutants seldom pay any attention to him until he stands before their cage. Furthermore, it takes two weeks for wild Gray rats to get used to a new caretaker, whereas the mutants mind the change very little.

Evidence was obtained that would indicate that a greatly reduced sense of smell may accompany the Albino gene in rats, and a strain of laboratory Albinos (latently purebred for Hooded and Black) was found to be completely insensitive to the smell of garlic that all other rats hate. Evidence was also collected that showed these Albinos unable to smell the garlic, but that they could taste it, hating the taste as other rats do.

The impairment or loss of the sense of smell by a rat would be something like the impairment or loss of vision would be to a human being, and it certainly does affect interpersonal relationships to a great degree, putting these creatures to a great disadvantage before their fellows as well as exposing them to other dangers of the environment.

Touch

We have no evidence upon the sense of touch in rats, but an observation drawn from mice would seem to indicate that an unusual coat texture or absence of hair may be acted upon by other rats in their interpersonal relationships. A litter of half grown mice included two hairless ones. A new litter was born in the cage and for a number of days two females made life miserable for the hairless members of the older litter by trying to drag them constantly into the nest with the naked newborns.

This curious interpersonal reaction on the part of the females would appear to be due to the lack of hair on the half grown mice being confused through the sense of touch with the lack of hair on newborns.

It may be suggested that some mendelian genes, as that for Hairless, may produce skins that are dulled in the sense of feeling, and in cases in which ulcers are present, an even more sensitive skin such as found in old Hairless rats. Both of these conditions will undoubtedly affect interpersonal relationships as preliminary observations have shown.

Quality of Voice

Because rats are more disturbed by sounds at high frequencies than at low frequencies, it would appear that voice modification may play an important rôle among rats in dealing with their fellows and in giving alarm.

The variations in voices of rats have been recorded and analyzed for a few adult males of several coat color strains as well as for wild Gray controls. The general voice characteristics have been given above for several strains. A summary of principal frequencies involved in these analyses is shown in the accompanying illustration that represents the upper half of a piano keyboard beginning with Middle "C". The frequencies indicated above the keyboard are given in cycles per second, assuming that the piano is tuned to "perfect pitch". The frequencies found in the voices of various rats are indicated by wedges placed directly below the key to which these frequencies correspond. Some very curious facts were uncovered by this study that probably affect interpersonal relationships. In general, the voices of mutants are raised in frequency of the fundamental, but this is done almost invariably with greatly reduced volume. There seems to be no modulation of voices by voluntary changes in shape of the voice apparatus, but all rats appear to raise their voices to higher and higher frequencies by sending air through the apparatus under greater pressure, so that the pitch of voice continues to mount higher and higher as additional multiples of the fundamental frequency are produced. The fundamentals of voices of mutants analyzed were raised with the exceptions of Curly Coated and Chocolate Pigmented rats, whose fundamentals remain similar to those of wild Gray rats. The Albino gene alone tends to change the general pattern of the voice as well as the position of the fundamental. When this gene was placed upon a wild Gray background, the animals tested developed voices with almost a pure single frequency of 2800 cycles per second, the quality of this voice sounding much more like a flute or whistle than a squeal.

Because a predominance of powerful tones at high frequencies gives to an individual rat a voice that sends terror into his fellows, any coat color, bringing with it a reduced volume, even though the fundamental is raised, will be of disadvantage, because wild Grays can and do produce more powerful voices at higher and higher frequencies merely by forcing air through the normal voice box under greater pressure.

Glands

Greater docility, lack of savageness and the taking of less exercise would be expected to reflect some glandular alterations, and correspondingly

evidence that the thyroids, adrenals and testes were reduced in most mutants was found in the dissection records of the late Dr. Henry H. Donaldson. These data were published by Keeler and King in summary.

A reduction of activity would put a rat at disadvantage in interpersonal relationships and would be expected to stem from some basal metabolic change. Schopbach, Keeler and Greenberg found that the Black metabolic rate was above that of the wild Gray but suggested that the Black rat burns its fuel with comparatively low efficiency. The heart rate was found to be increased slightly in Black mutants.

The lack of aggressiveness in coat color mutants with high voice fundamentals appears to be related to the reduced size of their testicles. The testicles of both Curly and Chocolate rats are of about normal size, their voices have fundamentals about as low as those of wild Grays, and they are aggressive fighters.

Because in the studies of Schopbach, Keeler and Greenberg hypothyroidism was ruled out as the cause of docility and tameness in the Black rat it is tentatively suggested that these characteristics are dependent upon a reduction of adrenal function. This possibility remains to be studied.

Muscle Tonus

No studies have been made upon the subject of muscle tonus; suffice it to say that the handling of the different breeds both alive and as carcasses gives one the distinct impression that the muscles of mutants in general are softer and flabbier than are those of wild Gray Norway rats. If this strong impression is proven by actual tonus tests, this fact is also to the disadvantage of the mutants in general.

Discussion

It would seem probable that much of the physical basis underlying differences in interpersonal behavior between wild Gray rats and their mutant coat color derivatives are due to the clipping off by the coat color genes of bits of the organism (by faulty development) here and there, in sense organs, brain, glands, size, general strength, voice and possibly other ways. To put it crudely, the laboratory mutant has so much of itself excised that it is really no longer a rat when compared with the unmutated members of its species. And because it is not a rat, it cannot be expected to behave as one.

These genes induce modifications similar to Darwin's "effects of domestication".

If we try to apply the findings of these studies to problems of interpersonal relationships in man, we must admit at once that, in general, the little push that a single gene makes in one direction or another on trends of behavior is so swamped, or modified or voted down in man by the thousands of other genes in the residual hereditary background of the individual that it would be extremely difficult to evaluate its specific effects or apply them to particular situations in behavior. However, in rats studied in the laboratory, by making identical the residual hereditary backgrounds for all individuals, the effects of particular allel-pair alternatives displayed upon the identical backgrounds will stand out clearly.

It is apparent, however, that the types of physical and physiological modification that we have shown to be brought about in the rat as pleiotropic manifestations of single genes that lead to altered trends in interpersonal behavior, actually have their counterparts in man and do affect his behavior in relation to his fellows, although less obviously.

It seems probable that the sense of smell plays an important role among primitive peoples who depend upon that sense more in their adjustments than do more civilized peoples, and yet the large perfume trade of the world is based upon the great extent to which odor still affects the daily lives of civilized peoples. Tea, coffee, tobacco and food trades are also affected. I have heard a European woman complain that she hated one of her grandchildren "because he does not smell like our people", and it is well known that strong and generally repulsive bodily odors are definitely inherited in families of cleanly habits. Persons so afflicted by bodily odors find it impossible to hold positions of refinement.

In those days when success depended more upon the ability of the individual in physical contests, the matters of body length and body weight played an important role. And, although reduced in value today, these factors are not without their influence in human affairs because, other things being equal, the tall, well-built man is preferred as a leader.

In the matter of voice, no one will deny the magnetism of the silver-tongued orator. Ask members of his audience what he spoke about and they will reply, "I really don't know what he said, but I remember that he had such a wonderful voice." Success in several professions of leadership and influence such as movies, radio, politics and the ministry are often bound up with the possession of a pleasing or effective voice.

We have mentioned modification of the glands that determine temperament changes to a great extent in rats: the thin, hyperthyroid, vicious Curlys and the friendly, plump, sluggish Blacks. It is a commonplace to

speak of the thin, hyperthyroid, human-dynamo type of man with his activity and drive in contrast to the fat, baldish, hypothyroid, affable wheel-horse that carries out directions faithfully.

Possibly the additional stimulus to brain desiccation induced by certain genes may affect human reactions to a certain extent as yet unmeasurable. We do know that early maturity of mind in a person is looked up to in youth, but the same individual will be forsaken as a leader in middle life should he begin to exhibit sluggishness of mental reaction that may conceivably accrue from accelerated cerebral desiccation.

It has been shown that a number of the factors we have examined in the rat and that we have demonstrated to be due to the pleiotropic effects of simply inherited genes also affecting hair form and pigmentation, do change interpersonal behavior in the Norway rat. We have noted that most of these same variations may modify interpersonal relationships in man, although here their influences are still subtle and defy exact evaluation.

It will be seen that in rats the possession of certain gene mutations in general, places a rat at a disadvantage before his fellows with regard to his interpersonal relationships through the general weakening of his body, the dulling of his sense organs and the calming of his reactions.

If an accumulation of mutant genes produces similar physical and physiological effects in man, and it seems probable that this is the case, then it may not be to the disadvantage of the possessor of these traits in dealing with his fellows in a world built on heterogeneity of capacity and ability. Calm and cool-headed persons, rather than kinetic, impulsive or explosive ones, usually serve us well in capacities of trust and judgment such as bankers and judges, who bear the confidence and respect of their fellow citizens.

Some day we may even find that such a dulling of the sense organs that tempers and to a certain extent shuts out stimuli and threats of the environment, a weakening of the body that destines man to construct with tools rather than do everything with his muscles, and a calming of his mental tempo that gives him time to think and plan, to tolerate others, and even to consider the welfare of his community as a whole (rather than to quickly hide, run or fight in response to disturbing stimuli), were important factors in bringing about the development of human civilizations in which millions of individuals live as basic units in a beneficial interpersonal relationship and socio-cultural unity. It is obvious that a colony of such unlimited size has been achieved by no other mammal, and we may owe this to an accumulation of just such behavior modifying genes as we have studied in the rat.

Summary

To summarize the foregoing argument, we may say that we believe that most of the behavior trends observed in coat color mutants having a common, residual hereditary background can be explained as due to several types of pleiotropic modification accompanying the presence of the coat color genes themselves affecting glands, nervous system, etc., namely, the genes for Chocolate, Curly, Hooded, Albino, Ruby-Eyed Dilute, and Waltzer. The effects are similar to those that Darwin thought due to the domesticative environment. These alterations are of the same nature as Darwin's modifications due to domesticative evolution.

It is suggested that valuable progress will be achieved in the experimental study of interpersonal relationships in rats when animals of identical residual hereditary background and bearing single coat-color-gene-induced behavior trends as well as animals bearing more complicated combinations of diverse single-gene trends can be raised to adulthood without handling with their own genetic type and then brought together with other individuals bearing similarly synthesized but diverse personalities so that the interpersonal reactions of different combinations may be observed, recorded and analyzed.

Whereas in man the measurement and evaluation of the effects of such variations upon interpersonal behavior is extremely difficult, we have shown that just such variations in build, glands and nervous system do affect materially the interpersonal reactions of human beings. These same factors may have had something to do with the development of civilizations.

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GROUP FORMATION DETERMINED BY SOCIAL BEHAVIOR; A COMPARATIVE STUDY OF TWO MAMMALIAN SOCIETIES

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Some of our most troublesome problems may be attributed to the fact that our social customs and organization have not changed as rapidly as the circumstances of our lives. To take an example, our popular economic mores are still based on the idea of individual action in an age when rapid transportation and communication have bound individuals inescapably together. This "cultural lag" can in part be remedied by furthering scientific studies of social phenomena, so that people may some day have as perfect techniques for controlling each other as they now have for mastering physical energy.

Many such studies are being done in the field of biosociology, a borderline area between sociology and biology which is attracting the attention of zoologists, sociologists, psychologists, and many others. The importance of this field arises from the fact that it is difficult to do direct experimental work on human beings. We need sociological studies on animals to provide the basis for a true science of comparative sociology. Whenever this is done it becomes possible to refer certain human problems to the proper animals for experimental solution.

However, it should always be remembered that an enormous gap exists between the social organizations of human beings and that of the most highly social animals. This gap is produced by language, and the difference in organization is perhaps comparable to that between one-celled and many-celled animals on the biological level.

This means that while fundamental and simple human social problems not involving language can be referred to animals for solution, it is almost never possible to draw a direct analogy from animal problems to human affairs. The complicating factor of language is always present and may entirely reverse the results.

It may be assumed that all human social phenomena are based upon the social activities of human beings; it would be difficult to imagine how any social organization could exist if people paid no attention to each other. But when we attempt to classify human social behavior in an objective way we run into serious difficulties, partly because of the difficulty of being objective and partly because of the fact that human social behavior goes on

almost continuously and hence is apparently impossible to separate into different categories. The problem may be properly referred for study in animals where obvious discontinuity may exist. In many animals social behavior is seasonal in occurrence, or one species may entirely lack a type of social behavior which is present in another.

Social Behavior of Sheep and Mice[1]

The social behavior of sheep and mice may be divided into several types, as follows: (1) allelomimetic behavior, or mutual imitation, (2) epimeletic behavior, or care and attention, (3) et-epimeletic behavior, the calling or signalling for care and attention, (4) sexual behavior and (5) fighting behavior. In addition to these there are three types which may be social but are often asocial in nature: (6) eating, (7) shelter-seeking and (8) investigation.

Allelomimetic behavior is prominent in both sexes and the young of sheep but is ordinarily entirely absent in mice. Epimeletic behavior consisting of grooming, nest-building and nursing is very marked in nursing female mice but is also found in males (except for nursing). Epimeletic behavior is much less prominent in sheep and found only in nursing mothers. Et-epimeletic behavior is found in the young of both animals. In both species sexual behavior of females is confined to heat periods, occurring every five days in mice and every sixteen days in sheep. The sexual behavior of males is not so limited, but that of both sexes in the sheep tends to be confined to the winter season. Fighting is prominent in the males of both species and often arises in connection with sexual behavior. The only social type of eating found in both species is nursing by the young. Shelter-seeking (mostly huddling together for warmth) is found in both animals but is seen more often in mice. Investigation is likewise more noticeable in mice, probably because it is chiefly olfactory and tactile rather than visual.

With the exception of investigation and allelomimetic behavior all types in the sheep show seasonal occurrence and so are discontinuous. When the mice and sheep are compared there is no allelomimetic behavior in the mice and so this type is discontinuous between species. (In other animals it may also be seasonal in occurrence.) Thus, even in these limited examples there is considerable evidence to show that this type of classification has a

[1]For further details see "Social behavior, organization, and leadership in a small flock of domestic sheep", Comp. Psychology Monographs (in press), and "Social behavior, range and territoriality in domestic mice", Proc. Indiana Acad. Science, 53:188-195, 1944.

basis in reality. Furthermore all of the important kinds of social behavior of the two animals are included in the classification.

Group Formation Caused by Social Behavior

It is fairly obvious that the formation of groups among human beings is bound to be the result of the activities of the persons who make up the group. For example, there can be no group if its members do not take the initial step of moving together. But here again it is difficult to observe the whole process of group formation and especially difficult to conduct experiments along these lines. This problem, like classification, may be referred for experiment and observation among animals.

Among the sheep and mice two approaches present themselves. From the analysis presented above it is found that sheep and mice show decided differences in social behavior. Therefore, the types of groups found in each should differ. To this "natural experiment" may be added the possibility of artificially altering the social behavior of experimental animals in one species.

The most important differences in social behavior of individuals seem to be connected with age and with sex. It is therefore proper to classify all individuals as either males or females or as young or adults.

Disregarding for the moment the sex difference in the young, there are seven possible combinations of the three types of males, females and young: (1) all males, (2) all females, (3) all young, (4) males and females, (5) females and young, (6) males and young, and (7) all three types together or males, females and young; where sex makes an important difference in the young each of these groups which contains young will of course be split into two, making four more combinations.

Now, the ways in which each of the above types (males, females and young) can differ from each other consists of differences in the eight general types of social behavior defined above. From the definition of these terms it would be expected that behavior would affect group formation as follows:

Allelomimetic behavior should tend to draw all types of individuals together provided they are capable of mutual imitation. Since, however, males, females, and young differ from each other in their other behavior it would be expected that there would be some tendency to form separate groups, each containing only one kind of individual. That is, there should be a tendency for males to form one group, females another and offspring a third.

Sexual behavior should of course tend to draw males and females together.

Fighting on the other hand should act as a disruptive force tending to break up groups and drive individuals apart.

Epimeletic behavior should tend to draw the active and passive participants together no matter what sort of individuals are concerned. Very commonly, of course, we would expect that epimeletic behavior would be exercised by a parent upon offspring which would respond with nursing and et-epimeletic behavior, both of which tend to draw a group together. Because nursing is possible only with female mammals this group should more commonly consist of a female and young than a male and young, or both female and male with young.

Shelter-seeking should form a group between any two animals regardless of age or sex but should be temporary in nature and dependent on fluctuations in the physical environment.

Investigation should likewise form a group between any two types but should be very temporary in nature and hence relatively unimportant.

With the exception of fighting combinations of two or more types of behavior should simply increase the cohesiveness of the group and widen the types of individuals which may be included. If epimeletic, allelomimetic and sexual behavior were all present one would expect a group consisting of males, females and young.

The effects of fighting in combination with other types should be to weaken cohesiveness and modify the nature of the group.

If the peculiar behavior characteristic of males, females, and young in the sheep are taken into consideration we should be able to account for the various groups observed on the basis of social behavior. Allelomimetic behavior is very strong in all types and sure enough we commonly find a group which includes males, females and young.

Likewise there is a tendency for separate allelomimetic groups to form on the basis of differences in behavior. While the mothers graze in a group the young lambs (which receive part of their nourishment in milk) play a short distance away in a different group. During this same season the rams tend to form a more active group of their own apart from the slower moving females and their lambs.

It would be expected that the short period of heat in the female would result only rarely in the formation of a male-female group. However, sexual behavior in the males is strong enough that it appears to hold them near the females during the winter months. An unexpected circumstance is that sexual behavior (of a semi-frustrated sort) seems to help to hold the ram group together when they are apart from females.

Fighting among sheep never seems to be strong enough to overcome the cohesive force of other types of behavior but does modify the groups so formed, particularly in the following ways. A ram will occasionally succeed in driving off other males from a ewe in heat, the result of which is that a group of two is formed, rather than a group consisting of a female and several males. Likewise the fact that the mothers drive off strange lambs results in the division of the group of females and young into subgroups each consisting of a mother and her own lamb or lambs.

Since epimeletic behavior occurs only in females it would be expected that the group of the males and young would not be formed in sheep, but rather a strong group of female and offspring would appear during the lambing season. Thus in the sheep all the theoretically possible groups except one (male and offspring), can be observed and its absence is accounted for by a peculiarity in sheep behavior.

A comparison may now be made with group formation in mice. In the first place there should be no group formed on the basis of allelomimetic behavior, i.e., either groups of males, females and offspring or groups containing one type only and this appears to be the case. When mice are raised in large pens they still act in a very individual manner.

Sexual behavior would be expected to have an effect similar to that in sheep, namely that a temporary male-female group should be formed. This group can be observed when the female mouse is in heat. Sexual behavior seems to have less effect in holding males together as it almost always causes a fight and there is no other behavior to keep the two together.

One would expect that groups formed on the basis of epimeletic behavior would be more extensive than in the sheep since a certain amount of this is seen in the males in the form of grooming, but these groups should be chiefly formed in the nests. What is actually observed is that a female will build a nest for her young in advance, and form a group with them in the nest up to the time of 16 days or so. After this the young begin to make trips from the nest returning to it for several days thereafter. As this group begins to break up the male may move into the nest in company with the young.

This last is presumably an effect of shelter-seeking which should be a much more important factor in group formation of mice than of sheep. Even in mice, however, the groups formed by shelter seeking are temporary and depend on fluctuations in the physical environment.

The principal differences between sheep and mouse behavior are: (a) the great development of allelomimetic behavior in sheep and its absence in

mice and (b) the greater emphasis on epimeletic, shelter-seeking and investigative behavior in the mouse. The result is that the typical sheep group is a number of sheep which are going somewhere, whereas the typical mouse group is a few mice more or less passively huddled together in a nest.

This natural experiment seems to confirm the theory that differences in social behavior are responsible for differences in group formation. This theory has not been extensively tested by artificial experiments, but the following example is confirmatory.

In order to test the effect of training upon the development of social behavior a lamb was isolated from other sheep at birth and raised on the bottle. She was kept entirely away from them for ten days, thereafter being permitted contact. She was curious and at first investigated them but they drove her away. The result was that she stayed away from the other sheep and developed almost no allelomimetic behavior except possibly with the people that fed her. The rather startling result of the experiment was the almost complete lack of allelomimetic behavior. As might be expected this sheep did not form a group with the other sheep until her first heat period and the subsequent arrival of her first lamb. Even at the age of three years she was still definitely independent of the other sheep and joined the group less often.

The experiment was repeated with a male lamb, the expectation here being that since sexual behavior develops so much earlier in male lambs he would join the group much sooner, and this was the case. Although much more independent than the other sheep this male tended to stick around other groups of sheep in spite of the rebuffs of the various mothers. These experiments need to be confirmed with large numbers but their results strikingly confirm the theory that group formation is caused by social behavior.

Asocial Behavior Causing the Formation of Groups

While social behavior appears to be extremely important in the formation of groups, it should not be supposed that it is the sole agency which can produce that effect. Animals may be attracted by the same concentration of food, or by the same favorable feature of the environment. In addition they may be held in a group by artificial barriers, as in most experimental situations.

The natural food of sheep consists of plants, more or less uniformly scattered over pasture land. Therefore food seeking and eating (with the

exception of nursing) usually causes sheep to scatter. However, if sheep are fed hay and grain in one spot they gather together to eat it.

The principle physical factor to which sheep have been seen to react is temperature. In summer the group may all be found in a single cool and shady spot, while in winter they may seek out a sunny slope or a place sheltered from the wind. The group is also held together by allelomimetic behavior, but it is obvious that the environment is producing an effect.

As an example of a group formed by artificial barriers, it was necessary during the early part of the breeding season to confine all rams to one field, although at this period the natural tendency would be to form one flock.

Food might be expected to be a more important factor in group formation among mice, whose natural food is often concentrated stores of human provender. However, in experimental pens where a plentiful food supply was placed in one spot, eating groups were seldom observed. It appeared to be a matter of chance whether two mice ate at the same time.

Mice, like the sheep, respond frequently to the temperature. When it is too hot a mouse will try to dig holes and when it is too cold he may build a nest (epimeletic behavior) and occupy it. Such a nest may attract other mice which come in and form a group—in this case both the social and asocial forms of shelter seeking occur together.

Finally, almost all observations on the social organization of mice have been done with groups artificially held together by barriers.

In conclusion, it is obvious that natural groups may be formed by the asocial forms of shelter-seeking and eating. As to artificial groups, any sort can be made up according to the design of the experimenter. It is probable that considerable caution should be exercised in making generalizations from work based on such group.

General Discussion

There is a great need for the complete analysis of the social organization of as many animal species as possible, as the present lack of general information makes it impossible to state with certainty that any general laws of animal sociology exist. However, the following outstanding examples taken from available studies indicate that social behavior may have some general importance as a cause of group formation.

W. C. Allee's basic work on "Animal Aggregations"[2] emphasized the importance of group formation as a fundamental stage in social organization.

[2]University of Chicago Press, 1931.

Among the lower animals shelter-seeking and sexual behavior appear to be the most important causes of group formation, although many other causes exist in higher animals. It may be added that long before the publication of this book Allee had experimentally confirmed the theory that behavior causes group formation. To take an example: if the small crustaceans known as sow-bugs are put into an unfavorably dry environment they respond with shelter-seeking behavior, and if the only shelter available is the bodies of their fellows, they form a group.[3]

The social organization of insects has perhaps been most satisfactorily explained by W. M. Wheeler[4] on the basis of reciprocal feeding (trophallaxis) which is, of course, a part of epimeletic behavior. In the case of most ants[5] the types of behavior seen are sexual, epimeletic, et-epimeletic, fighting, investigation, and possibly shelter-seeking. Fighting is never directed against members of the same colony. Sexual behavior occurs only in the males and females during the brief nuptial flight. The majority of an ant colony are the sterile females or workers whose behavior is predominantly epimeletic and directed toward the eggs, larvae, the mother female or queen, and each other. As might be expected, the chief groups of ants are formed around the young and female within the nest, although occasionally a pair of workers will come together in the open, investigate each other with antennae, and perhaps share a drop of honey-dew.

Now, the workers of the so-called "army" ants recently re-studied by T. C. Schneirla[6] show a marked degree of allelomimetic behavior and form columns whenever brought together. Correlated with this is the fact that these ants are always found in groups outside the nest as well as in it, the nest being a temporary affair.

Group formation among birds is of unusual interest, since in many species there are sharp seasonal differences in social behavior as well as strong tendencies to stay in specific localities. J. W. Scott's paper on the sage grouse[7] will serve as an example of results attained from many excellent studies. During the winter both males and females are strongly allelomimetic. In early spring sexual behavior begins for both sexes, and fighting appears in the males. At this period both sexes frequent special mating grounds. After mating, allelomimetic behavior of the females is replaced

[3] *Jour. Exp. Zoölogy*, 45-255-277, 1926.
[4] *Social Life Among the Insects*, Harcourt, Brace, N. Y., 1923.
[5] W. M. Wheeler, *Ants*, Columbia Univ. Press, N. Y., 1910.
[6] Proc. Am. Philosophical Society, 87:438-457, 1944.
[7] Auk, 59:477-498, 1942.

by epimeletic and only reappears in the fall. During the summer sexual and fighting behavior of the males ceases. Correlated with these changes are found (a) groups of males, females and partly grown young during the fall and winter, (b) remarkably complex groups of males and females on the breeding grounds in spring, (c) groups of males in summer, and (d) groups each consisting of a female and young during summer.

But perhaps the most interesting results which can be quoted are C. R. Carpenter's field studies on the howling monkey[8] and the gibbon.[9] Both animals are arboreal and live in tropical regions. As in most primates, the non-pregnant females of both species exhibit prolonged periods of sexual activity and probably show no period in which the male is completely rejected. Both animals show allelomimetic behavior in all individuals, but the trait is probably more marked in howlers. Gibbon males show some epimeletic behavior toward their young while male howlers show almost none.

There is, however, a marked difference in fighting, which is almost entirely absent among howlers, whereas male gibbons fight each other viciously, and so do the females. Correlated with these differences are the following facts: the typical howler group is composed of several adult males and females and their offspring among whom there seems to be no strong sub-grouping except that of each female and her recent offspring; the typical gibbon group consists of a single adult male, a single adult female, and their offspring. This is a striking example of the dividing and limiting effect of fighting upon group formation.

Human Applications

Considering the almost universal human tendency to generalize broadly from limited information, it is advisable in a paper such as this to conservatively estimate a reasonable degree of generalization and precisely indicate its scientific limits. Thus it may be said in general that the idea that human group formation is caused by the behavior of its members, social and otherwise, is given considerable support by the facts cited in this paper although they do not constitute absolute proof. It may be said accurately that in animals group formation is often caused by social behavior and in some cases may also be caused by other sorts of behavior.

Another and perhaps more important idea emerges from these facts, namely, that different sorts of social behavior produce different sorts of

[8] *Comp. Psychology Monograph* No. 48, v. 10, 1934.
[9] *Ibid.* No. 84, v. 16, 1940.

animal groups. Because of the possibility that this might also be true among people it might be advisable to preface the analysis of social organization within a human group by the observation and classification of the social behavior of its members. But it must be remembered that the situation may be profoundly modified by language; a difference in cultural training may entirely eliminate or unduly emphasize one sort of social behavior in a given human being.

Added to this, there seems to be greater genetic variability among human beings than in most species of wild animals. One can never assume, as in many animal cases, that a given adult male will automatically show a certain type and amount of social behavior; he must be observed individually.

With these precautions it is possible to go ahead and make certain comparisons between human and animal group formation. In the first place it is obvious that many important human groups in a society are not formed by the direct action of social behavior between the members. For example, the group formed by children on their first appearance at school is caused chiefly by the social behavior of each child toward his parents rather than the other children, most of whom he may never have seen before. As J. L. Moreno[10] has pointed out such groups function more efficiently if formed on the more natural basis of the social reactions of the members toward each other, as indicated by their likes and dislikes.

On the other hand, if Moreno's "social atom" concept is applied to animal material, other interesting correlations are obtained. A "social atom" is defined as the interacting attractions and repulsions between one individual and all others with whom he has contact. Considering that it was worked out entirely independently of animal material, there is a startlingly close relationship between this idea and the analysis of group formation presented in this paper. That is, the eight different types of social behavior represent different *ways* in which animals attract or repulse each other.

It follows that in spontaneously formed animal groups such as those which develop from a small bunch of sheep allowed to roam freely in a large territory, the "social atom" for any sheep would tend to coincide with the group of which he was a part. If it could now be determined which human groups come near to coinciding with social atoms, considerable possibilities might be opened up both for theoretical analysis of human social organization and for further solution of practical problems through

[10] *Who Shall Survive?* Beacon House, New York, 1934.

the method of organizing new groups functionally rather than arbitrarily.

In conclusion, the student of general social problems is always impressed by the need for gathering more and more correlated information on the subject. We need not so much facts as systematically gathered facts which can be related to each other and correctly applied or not applied to human problems. This can best be done in an atmosphere of cooperation and goodwill including all related sciences, and the author believes that the symposium of which this paper is a part is a desirable step in that direction.

INDUCED CHANGES IN THE BREEDING HABITS OF FOXES

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The silver fox has been raised in numbers on fur farms and ranches for about 50 years. The pelt of the silver fox is of great value because of its beauty, and because this color phase of the common or red fox is rare in the wild. Since the silver fox and red fox are brothers under the skin, it was assumed, and quite correctly, that the habits of the red fox and silver fox were similar, and the pioneers in the industry based their success on following a system of breeding similar to that of the wild fox. For many years no attempt was made to change the breeding habits or to domesticate the animals.

Trying to follow as closely as practical habits observed in the wild, ranchers placed a male and a female in a pen enclosure and left them together. Some ranchers removed the male when the pups arrived in spring, while others permitted mated pairs to run together the year 'round. After the pups were weaned or after breeding stock had been selected in early winter, the animals were placed in pens; a male and female to each enclosure. This was known as the mated pair system and is still practiced extensively.

As knowledge acquired through the study of breed improvement of domestic stock increased, attempts were made to improve the silver fox by trying to breed superior males to more than one female. This system is known as polygamous mating. It is with the differences brought about by the change from monogamous to polygamous matings that this paper deals.

In spite of the abundance of the red fox, even in well settled districts, accurate observations on the mating or pairing of the fox are scanty. Most observers agree that the association of the male and female as a pair extends well beyond the limits of the breeding season, and all agree that under normal wild conditions foxes are monogamous. This tendency toward monogamy is very evident on fur farms and has been a great handicap to production. But this strong tendency can be changed by proper methods of handling and training the males. Thus a profound change in the inter-relations of the male and female is being produced by man.

One wonders whether the domestic animals of man, chiefly the dog, ever paired and mated in the wild only to have a monogamous mating habit change through man's control during domestication. There are indications

of strong preferences between some dogs that suggest more permanent relationship. A paper by Murie (1944) on the wolf *(Canis lupus pambasileus)* indicates that the composition of the wolf family, using family in the sense of all wolves that have headquarters about an occupied den, is far more complex than usually reported.

The captive female fox, as a rule, will stand and mate with almost any male, stranger or no stranger, when she is in heat. She may initiate play if the male is not aggressive. It is the male that is the problem in the eyes of the fur rancher, for only careful training and handling will produce a male that will copulate with a strange female without too much hesitation, and such a male can be ruined for polygamous mating by spending too long a period with one female. In order to train a male to be polygamous, once he has reached maturity he is never caged overnight with a female. The usual practice is to initiate him to copulation by placing in his cage an experienced female in full heat. The female is removed after an hour or two, or after copulation. If the male does not copulate, another female is placed with him for trial. Under this system some males never copulate but most of them become "polygamous." But even the most polygamous males caannot be depended upon to mate with every female presented, even though considerable time has elapsed between opportunities for copulation.

In addition to the change in behaviour of the male induced by using a polygamous system of mating, there is a change produced in the female. The service director of a large association of fox ranchers reports that when ranches go over to polygamous matings vixens come in heat later in the season than when the system of mated pairs is used. This supports the observations of many breeders who believe that the pairing of the male and female hastens heat. It is possible that play and activity have more to do with this than direct stimulation centering about sexual activity in the restricted sense. Whatever the cause may be, Bassett and Pearson (in press) suggest that association with the male at frequent intervals is enough to accelerate estrous in the female. Females cagaed together tend to quarrel frequently during the pre-breeding season and are otherwise more active than when caged alone; and some observers believe that females in the same cage tend to come into heat at the same time. If this last is true the hastening of estrous is by association with another animal, either male or female, and is not a specific male-female relationship.

Another result in changing from caging pairs to polygamous matings is the higher percentage of non-gravid females. This is due, possibly, to the failure of the caretaker to recognize the proper time in the cycle at which to

expose the female rather than to any change in the reproductive processes, for research on the relation of the onset of heat to ovulation and of ovulation to fertilization indicates that these 'misses' are due to failure to breed at the optimum stage in the cycle.

That the relationships reported here are simplified in statement is obvious. However, both field observation and work on captive foxes indicates that the inter-relationships of the mated pair are simpler than in many wild mammals such as the wolf (Murie, 1944).

CONCEPTS AND PROBLEMS OF PRIMATE SOCIOMETRY

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Detailed descriptions of primate groupings have been published and these can be consulted by those who are interested. A selected bibliography is given with this article. Although only a few of the hundreds of known species of sub-human primates have been intensively studied, enough information is available to show what the problems are and to illustrate concepts and methods which can be used to solve them.

This paper deals primarily with theory and methodology. The emphasis is on those phases of procedures for studying free-ranging monkeys and apes which relate to the sociometric techniques and concepts.

Requirements for Field Studies

Sample populations and feasible environments are selected for the species to be observed before a study of wild primates can be successfully completed. Ideally, animal subjects and environments are selected which have not been molested or modified by man. The animals are most validly studied in that environment which has operated selectively on the evolution of the species and to which the subjects are fittingly adapted. Primate types and field locations are chosen, furthermore, which favor the application of observational and photographic recording procedures. Prolonged and intensive observations are required in order to yield adequate and reliable results. Methods of work are developed or applied which least disturb the normal behavior of subjects. All of these selection requirements are made necessary by either practical or theoretical considerations.

Generally it is desirable in studies of free-ranging primates to collect data which, when organized, will permit comparisons of the groupings and social behavior of a number of selected species or genera. However, due to special reactions of some types, or features of the environments where they are studied, data are sometimes collected which cannot be used for purposes of comparison. Whenever comparisons are to be made, common behavioral and social characteristics are defined and similar methods used for studying those characteristics of different genera and species (4).

Monkeys and apes cannot be *abstracted* from their natural environments for on these their natural behavior depends. Therefore, when the question of *how* a kind of primate behaves is answered, it is necessary to describe, in addition, those situations in which the behavior occurred. Since, however, different species are selectively adapted to different environments,

it is impossible to hold a large group of factors constant for comparative purposes. For example, there is some evidence to show that the grouping patterns of rhesus monkeys varies for those living mainly on the ground and those in heavily forested areas (3). The sizes of groups differ also between areas where food is scarce and widely dispersed and areas where food is abundant and concentrated.

Characteristics of Primate Groups and Problems of Studying Them

Available information shows that genera of sub-human primates have characteristic patterns of groupings and social reactions (5). For every type selected for study, therefore, adequate data are collected for describing these characteristics and their variability. For example, when it is required to know the size of groupings or the socionomic sex ratios (the relative number of males to females living in groups) of a particular kind of primate, enough groups must be enumerated to represent the range as well as the average size and socionomic sex ratios.

The observer of free-ranging primates in their natural habit is impressed by the complexity of their groupings and social interactions. These complexities cannot be accurately represented by statistical data only on the number of animals of different ages and sexes living in groups. Each individual may theoretically interact with every other one in the group. Each animal moreover, has its own variable social or group status. Furthermore, the organized group has internal boundaries or cleavages which must be considered. Because of these sub-groupings, some individuals are restricted in their movements and social interactions while others, which are more dominant or have more extensive social tolerance or prestige, are accepted throughout the group.

At least two approaches are possible in describing primate groups. An attempt can be made to describe the *group as a whole* or each possible elemental relation can be described and these descriptions re-composed to represent the entire group. Actually the field observer does both.

In order to represent whole groups which are organized and function cohesively, statistical enumerations must be supplemented by scatter plots or maps which represent patterns or forms of groups. Although this method of representation has not been used intensively, it holds promising possibilities. The technique is seemingly practical when applied to types of animals in situations which are favorable to this kind of research.

In order to *map* the pattern or form of a group, the first requirement

is that each animal be identified. Secondly, the interactions must be recorded of each individual with every other socially accessible animal of the group. This can be done on a sampling basis provided the sampling in terms of number of interactions and time is adequate for reliability. Thirdly, in order to evaluate strength or intensity of interactions, data must be collected on spacing and the duration of associations. And finally the quality and amount of behavior exhibited during interactions must be specified.

The application of these procedures to the study of groupings results in data which can be so presented as to represent the many features of a group structure as a whole. Dominant individuals can be represented as can sub-groupings of both relatively temporary and fairly permanent types. The main key to group mapping of this kind is to record the average spacial arrangements and the mean or average duration of these spacings. The strength or intensity of a relationship is inversely proportional to average spacing and directly proportional to duration of association. This viewpoint seems to have much in common with basic sociometric concepts.

A full explanation of behavioral interactions requires not only that time-space relations be measured but also that the quality and strength of the interactions be described. For example, assume that the interactions of two males are under study. The animals are continuously together, i.e., the spacing is close and long continued. Actual interactions are enumerated. If no further data are collected, basic facts for describing the relationship are not very meaningful. However, if in addition, the quality of behavioral interactions is described, the relationship takes on much more significance. If the reactions are homosexual, playful or pugnacious, then different meanings are implied. The causes for the relationship are understandable and future interactions are indicated.

When attention is directed toward a single relationship between two individuals, the interactions are found also to be complex and for some purposes require detailed analysis. Generally the interactions have two qualities; either they are in some degree antagonistic or affinitive. However, these qualities may be said to be *organismically summated,* i.e., both positive and negative factors are involved but the elements with similar sign which predominate in strength determine the observable quality of the relationship. For example, during the early stages of estrus (sexual receptivity), of a female rhesus monkey, a male which she approaches reacts typically to her approaches by attacking and biting her. She may be seriously wounded but nevertheless the approach reactions are continued and a close and persisting association is eventually formed (3). The sexual motivation (with positive

sign) of the female exceeds in strength the results of antagonistic responses (with negative sign) of the male. Therefore, the summated interactions give an affinitive quality to the relationship. When the behavior of the male is observed it is noted that initial antagonistic responses are superseded by affinitive responses following persistent sexual stimulation. He no longer drives the female from his envelop of individual space as he would do at other times but accepts her in the closest kind of association until he is either sexually exhausted or is replaced by a more dominant male.

It would seem as if in any unilateral interactions between two primates a number of positive and negative, drive-incentive interactions, elements are involved and, to repeat, those motivational elements which are greatest in *sum* or *product* characterize the complex relationship. In an affinitive relation elements of negative sign weaken it but do not change its overall affinitive quality. Likewise elements of positive sign may modify but not entirely change an antagonistic relationship.

In this kind of analytical study, gross observations of space-time associations and the counting of interactions may fail to yield definitive results unless behavior quality is considered. When a pair of primates are closely associated during the female's estrus, for example, and sexual motivation in both individuals is strong, negative elements are eclipsed by the strong sex drives. When, however, the sex drives are reduced in strength after repeated copulations, the antagonistic elements are expressed in behavior and can be observed. These successive changes should be described and, if possible, measured.

Analysis of the Concept of a "Social Relation"

Considerations of primate social behavior lead to questions of what, in operational terms, is meant by a "social relation" in the study of primate groupings. The concept of a relation has often been used as if referring to a real, objective phenomenon. The concept has often been reified. Actually nothing of a relationship exists outside of, or external to, the participating organisms. It is suggested that what should be meant by a "social relation" is the reciprocal interaction of the behavior of two or more individuals which stimulate and respond to each other. The behavior, in turn, should be considered as expressions of individual motivation or physiological processes. The quality of the behavior of the participating individuals is the basis for the observer's inference that similar reactions may have occurred and will occur again. To describe a single "relation" over simplifies the extremely difficult task of describing simultaneously

occurring, complex behavioral interactions and their successive changes. The complexity of interactions is great indeed when groups contain large numbers of individuals.

In this connection, there is danger of anthropomorphic thinking when dealing with animal "societies". Proof is lacking that even the highly developed sub-human primates have anything which is even analogous to human kinship relations, relations of obligation based on customs or precedent, and relations of agreement or contract.

Social Controls of Primates

Primate groupings are so organized and structured that social control rests with each individual group. This intra-group control is based on some degree of dominance, usually of the males but in some cases of females. Groups of some species are largely controlled by a single dominant male. Although organized groups, especially of the same species, compete with each other for territory, access to favorable habitats and feeding areas, the troops, bands or families of monkeys or apes do not have remote, extra-group social controls. Studies of primates have not yet shown them to have anything which corresponds to the extended controls exercised over members of some human families by selected and remote individuals or groups. Primate groups are controlled by the interactions among adults, usually males, of the immediate group and by direct competition between groups.

This fact is favorable for the application of sociometric concepts and procedures to the study of sub-human primate social interactions. It well may be that it would prove profitable to check the validity of new sociometric procedures by applying them to primate groupings before they are used very extensively on human subjects. Since the interactions of primates are more direct, contemporary and overt than those of man, and since the reactions are less camouflaged and less inhibited or distorted by learned social customs, the basic modalities of motivation are comparatively more clearly observable in primates.

Effects of Conditioning and Learning

The social interactions of sub-human primates are subject to modification by conditioning and learning. Continuous observations, for adequate periods of time, show that the intra-group associations change. The changes are usually gradual but may take place in a short period of time. Young males which have matured sexually but which do not have the strength to maintain a low-order dominance rank and be accepted in the group may

be driven out by repeated attacks by dominant males and females. The young males become "negatively conditioned" to the group as a whole and avoid it. Two mature males, to cite another example, with low dominance ranks may learn that the social status of each reinforces that of the other. If they stay together and coordinate their behavior, both are able to maintain social statuses in the group against the resistance of other animals. Social statuses are summated. When successive sociometric charts are made of the space-time associations and their changes, the results of social conditioning, of learning and of social summation can be reliably and validly represented.

Summary

The requirements have been stated for studies of free-ranging primates.

Some of the characteristics of primate groupings and the problem connected with their study have been described.

A question has been raised about the meaning of the term "social relation".

It was pointed out that primate social control is effected by behavioral interactions in the immediate group and by direct competition between groups.

Sociometric techniques are suggested as one means of measuring changes which result from social conditioning and learning.

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SOCIOMETRIC METHODS IN ANTHROPOLOGY

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Sociometric methods will become an indispensable part of the equipment of every field worker in anthropology. Indeed, I predict that sociometry will become the fundamental method of investigation. Sociometry is ideally suited to the conditions with which the ethnographer is confronted. It provides him with a basic instrument for the primary organization of those conditions into an efficient system. The groups among which the ethnographer works are usually made up of a relatively small number of persons, it therefore becomes a perfectly feasible project to map the interactive relationships which exist between all persons in the group to one another. Such a sociometric mapping of a group would not only yield an invaluable account of the social physiology of the group, it would also provide a more accurate picture of the culture as a whole than is obtainable by the usual means of ethnographic investigation. This is not to suggest that the usual means of ethnographic investigation should be jettisoned in favor of an exclusively sociometric approach. The methods of the ethnographer in obtaining texts, in his choice of informants, in his study of social organization, religion, technology, economics, etc., are continually being refined and will continue to be indispensable. There can, however, be little doubt that sociometry will endow all these methods with a more unified functional value, and will provide the investigator with a more wholistic insight than he has in the past possessed.

The nearest approach to a sociometric method in anthropology at the present time is the functional method associated with the name of Malinowski. But whereas functionalism is to anthropology as physiology is to anatomy, sociometry is to functionalism as histology and biochemistry is to physiology. Sociometric methods are more microscopic, more analytically refined than the grosser functional methods in use in anthropology today, and at the same time likely to be more revealing of just those relationships which the ethnographer seeks to uncover. In point of fact the trend in recent ethnography has been very definitely in the direction of a more miscroscopic approach to the study of human groups. The works of Bateson (1), Bateson and Mead (2), Kardiner (3), Simmons (4), Du Bois (5) and many others are good illustrations of this tendency.

At the present time we are witnessing the beginning integration of the social and psychical and relevant biological sciences in the study of man

as a functioning interacting unit in the social continuum. In that integration, I believe that sociometry is destined to play an important part. The sooner anthropologists become acquainted with the literature of sociometry, the better (6).

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THE TWO SOCIOMETRIES, HUMAN AND SUBHUMAN

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Dr. Gardner Murphy made a remark[1] which has become prophetic. "If sociometry is to be effective, it must be quick both to give and to receive, glad both to learn and to teach. The success of sociometric work . . . will depend on the willingness of each discipline to learn from another and the capacity of each discipline to adapt itself to the changing need of sister sciences." The present symposium well illustrates Murphy's statement.

Methodological Differences

Human sociometry started with a revolution in methodology. Indeed, looking back now to its beginnings as time goes by, the shift in method appears more significant that the evidence obtained to date. It started with a critique of the instruments of social investigation themselves, and last but not least, with a critique of the social investigator. The critique of antiquated social instruments was at one time formulated as follows:[2]

> We cannot adequately comprehend the central direction of an individual in his development either through observation, for instance, a child, through watching its most spontaneous expression, its play life, or through partnership. We must make him an experimenter. Considering group formation, we must make the members of the prospective groups themselves the authors of the groups to which they belong . . . The problem was to construct a test in such a manner that it is itself a motive, an incentive, a purpose, primarily for the *subject* instead of for the tester. If the test procedure is identical with a life-goal of the subject he can never feel himself to have been victimized or abused . . . From the point of view of the subject it is not a test at all and this is as it should be. It is merely *an opportunity for him to become an active agent in matters concerning his life situation.*
>
> The other fundamental aspect of the problem concerns the investigator, himself. In the social sciences, the problem of the investigator and the situation in which the experiment or study is to be carried out have been of the gravest concern. However, the methods for dealing with this fundamental dif-

[1]See Gardner Murphy, "Editorial Foreword," *Sociometry,* Vol. 1, part 1, July, 1937.
[2]See J. L. Moreno, "Who Shall Survive?", 1934, pp. 12-16.

ficulty have been most unsatisfactory, to date. Let us consider two of the most advanced of these approaches: the method of the participant observer and the method of the psychoanalyst. The participant observer, in the course of his exploration, enters into contact with various individuals and situations, but he, himself—with his biases and prejudices, his personality equation and his own position in the group—remains unexamined and therefore, himself, an unmeasured quantity. The displacement in the situation to be investigated which is partly produced by his own social pattern does not appear as an integral part of the findings. Indeed, we have to take the inviolability of his own judgments and opinions for granted and the "uninvestigated investigator" constitutes, so to speak, an ever-present error. The psychoanalytic investigator is also an unknown quantity in the situation in which he operates as an analyst. Any educational psychoanalysis which he may have undergone at an earlier date does not alter the fact that he is not measured during the process of interviewing and analyzing any individual. Indeed, in order to accomplish the evaluation of both analyst and patient, a third person—a super-analyst—who is in equal relationship to both, would have to be present during the treatment situation—and yet aloof from it. The direction of his treatment and his interpretation of the material gathered is totally subjective. At the time there is no frame of reference in the situation except his own opinion, which can provide a basis for determining whether the material has been secured in the proper fashion or whether the significance he assigns to it is scientifically valid.

In order to overcome the grave errors which may arise in and from the investigator himself, we resort to a sociometric approach which is especially adapted to the microscopic study of individual phenomena. The participant observer—in one particular form of this work—does not remain 'objective' or at a distance from the persons to be studied: he becomes their friend. He identifies himself with their own situations; he becomes an extension of their own egos. In other words, the "objective" participant becomes a "subjective" one. As a subjective participant he can enter successively or simultaneously into the lives of several individuals, and then function as a medium of equilibration between them . . . The investigators to be tested are placed in life-situations and roles which may occur in the community or in their own private lives until their ranges of roles and their patterns of behavior in these life-situations have been adequately gauged. This procedure is carried on until every one of the investigators is thoroughly objectified. Re-tests are made from time to time in order to keep pace with any changes which may have taken place in their various behavior-patterns. In the course

> of such work, the range of roles and the range of expansiveness of each investigator become clearly defined and the stimulus which he may be to the subjects of his investigations has become a known quantity. Thus, the . . . procedure provides a yardstick by which we can measure and evaluate an indefinitely large number of investigators in specific life-situations and in specific roles. The paradox is that the investigator, although he has become objectified by this process—a "controlled participant observer," so to speak—still continues to be "a subjective participant.[3]" He has vanished as a special agent outside of the group, but returns in a new form inside of it. The investigator becomes an anonymous member. As a result, the group itself has become *self-propelling, self-investigating* and *self-controlling.*

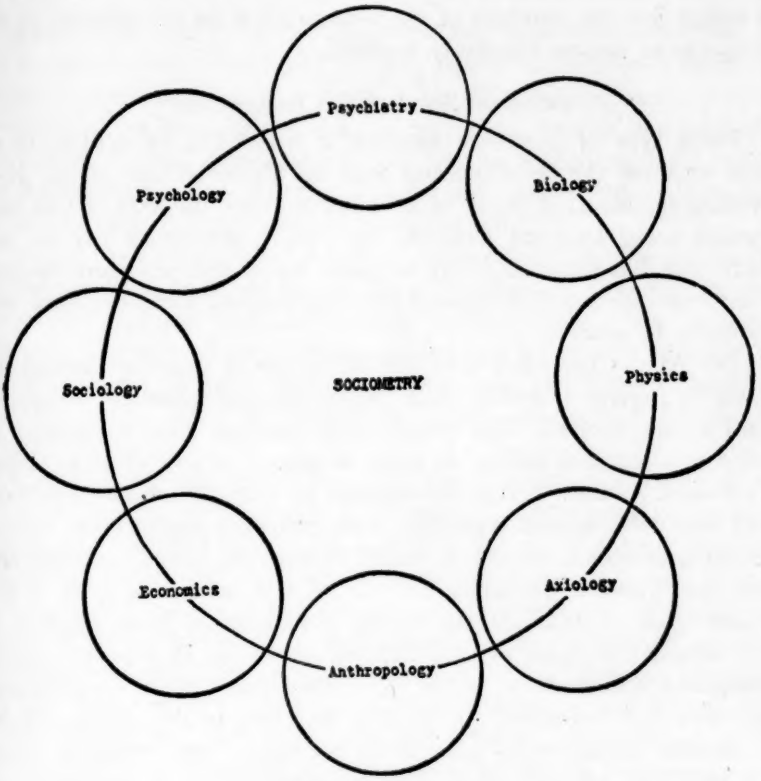
The anonymous influence of sociometry, more than the conscious one, has been largely responsible for a growing revisionism in the social sciences in the last two decades, the most all-inclusive since the time of August Comte and Charles Darwin. New instruments of investigation have been invented. *Action methods, participation methods and realization methods are more and more enveloping observational, interview and analytic methods.* The consciousness is maturing that lasting and central social control of human groups is not possible without central and adequate motivation of all its subjects in their behalf.

My critique, however relevant it was and still is, on the level of the human group, has little relevance on the level of the subhuman group. There is no *depth* to the subhuman groups which observation and experiment could not detect. All social structures are on the surface, none are hidden from the observer. But if there would be any, metaphorically speaking, then action-, participation- and realization methods would have to be instrumented by the animal participants themselves, the hens, the pigeons, or the primates, each within their own social sphere. Although therefore, the study of the social life among animals has profited greatly from observation, manipulation and experiment, these instruments are not sufficient for the human group.

As we have to know the actual structure of a human group[4] not only at one given moment but in all its future developments, we must look forward to the maximum spontaneous participation of every individual in all

[3]See J. L. Moreno, "A Frame of Reference for Testing the Social Investigator," *Sociometry*, Vol. 3, No. 4, October, 1940.

[4]The following pages are largely taken from J. L. Moreno, "Sociometry in relation to other Social Sciences" *Sociometry*, Volume I, 1937, pp. 207-215.



SOCIOMETRY*
Its Boundaries and Fields of Research
Primary Territory: The Human Group.
Secondary Territory: The Subhuman Groups.

future time. The problem is how to motivate men so that they all will give repeatedly and regularly, not only at one time or another, their maximum spontaneous participation. This difficulty can be overcome through fitting the procedure to the administration of the community. If the realization drive in regard to association with other persons or in regard to objects and values are aided officially and permanently by respective community agencies, the procedure can become *repeatable* at any time, and

*This chart and text is reprinted from "Sociometry and the Cultural Order," *Sociometry*, Vol. VI, No. 3, August, 1943.

the insight into the structure of the community in its development in time and space can become constantly available.

Types of Sociometric Procedures

Every type of procedure enumerated below can be applied to any group whatever the developmental level of the individuals in it. If the procedure applied is, in degree of articulation, below the level of that which a certain social structure demands, the results will reflect but an infra-structure of that community. An adequate sociometric procedure should be neither more nor less differentiated than the assumed social structure which it is trying to measure.

One type of procedure is to disclose the social structure between individuals by merely recording their movements and positions in space in regard to one another. This procedure of charting gross movements was applied to a group of babies. It could be applied to any group of animals, f.i. primates. At their level of development no more differentiated technique could have been applied fruitfully. This procedure discloses the structure developing between a number of babies, between the babies and their attendants, and between the babies and the objects around them in a given physical space, a room. At the earliest developmental level, physical and social structure of space overlap and are congruous. At a certain point of development the structure of the interrelationships begins to differentiate itself more and more from the physical structure of the group, and from this moment onward social space in its embryonic form begins to differentiate itself from physical space. The sociogram is here a diagram of positions and movements. A more highly developed structure appears when the children begin to walk. They can now move towards a person whom they like or away from a person whom they dislike, towards an object which they want, or away from an object which they wish to avoid. The factor of nonverbal, spontaneous participation begins to influence the structure more definitely.

Another development of the procedure is used in groups of young children who (before or after walking) are able to make intelligent use of simple verbal symbols. The factor of simple "participation" of the subject becomes more complex. He can choose or reject an object or person without moving bodily. A still further development of the procedure sets in when children are influenced in their making of associations by the physical or social characteristics of other people: sex, race, social status, etc. This factor of differential association signifies a new trend in the de-

velopment of structure. Up to this point only *individuals* stood out and had a position in it. From here on associations of individuals stand out and have a position in it as a group. This differentiating factor is called a *criterion* of the group. As societies of individuals develop, the number of criteria around which associations are or may be formed increases rapidly. The more numerous and the more complex the criteria, the more complex also becomes the social structure of the community.

To peck and to be pecked is such a criterion for hens. But the pecking is entirely overt. It is simply an act. There is apparently no conflict between *choosing* to peck one hen and pecking another instead. But in human groups the divergence between choice process and act process produces difficulties unknown to hens. There may be some point in the evolution of subhuman groups when the divergence between choice and act becomes gradually manifest.

These few samples may make clear that sociometric procedure is not a rigid set of rules but that it has to be modified and adapted to any group situation as it arises. Sociometric procedure has to be shaped in accord with the momentary potentialities of the subjects, so as to arouse them to a maximum of spontaneous participation and to a maximum of realization. If the sociometric procedure is not attuned to the momentary structure of a given community, we may gain only a limited or distorted knowledge of it, and it may never attain a fair and lasting degree of self control.

The participant observer of the social laboratory, counterpart of the scientific observer in the physical or biological laboratory, undergoes a profound change. The observing of movements and voluntary association of individuals has value as a supplement if the basic structure is known. But how can an observer learn something about the basic structure of a community of one thousand people if the observer tries to become an intimate associate of each individual simultaneously, in each role which he enacts in the community? He can not observe them like heavenly bodies and make charts of their movements and reactions. The essence of their situations will be missed if he acts in the role of a scientific spy. The procedure has to be open and apparent. The inhabitants of the community have to become participants in the project *in some degree.* The degree of participation is at its possible minimum when the individuals composing the group are willing *only to answer questions about one another.* Any study which tries to disclose with less than maximum possible participation of the individuals of the group the *feelings which they have in regard to one another is near*-sociometric. Near-sociometric procedures of the research or the

diagnostic type are of much value. They can be applied on a large scale, and within certain limits without any unpleasantness to the participants. The information gained in near-sociometric studies is based however on an inadequate motivation of the participants, they do not fully reveal their feelings. In near-sociometric situations the participants are rarely spontaneous. They do not warm up quickly. Often an individual, if he is asked, "Who are your friends in this town?" may leave one or two persons out, the most important persons in his social atom, persons with whom he entertains a secret friendship of some sort which he does not want known.

The observational method of group research, the study of group formation from *outside* is not abandoned by the sociometrist. This becomes, however, a part of a more inclusive technique, the sociometric procedure. In fact, sociometric procedure is realizational and observational at the same time. A well-trained sociometrist will continuously collect other observational and experimental data which may be essential as a supplement to his knowledge of the *inside* social structure of a group at a particular time. Observational and statistical studies may grow out of sociometric procedures which supplement and deepen structural analysis.

The transition from near-sociometric to basic sociometric procedures depends upon the methods of creating the motivation to more adequate participation. If the participant observer succeeds in becoming less and less an observer and more and more an aid and helper to every individual of the group in regard to their needs or interests, the observer undergoes a transformation, a transformation from observer to auxiliary ego. The observed persons, instead of revealing something, more or less unwillingly, about themselves and one another, become open promoters of the project; *the project becomes a cooperative effort*. They become participants in and observers of the problems of others as well as their own; they become key contributors to the sociometric research. They know that the more explicit and accurate they are in expressing what they want, whether it is as associates in a play, as table mates in a dining room, as neighbors in their community, or as co-workers in a factory, the better are their chances to attain the position in their group which is as near as possible to their anticipations and desires.

The first decisive step in the development of sociometry was the disclosure of the actual organization of a group. The second decisive step was the inclusion of subjective measures in determining this organization. The third decisive step was a method which gives to subjective terms the highest possible degree of objectivity, through the function of the auxiliary ego.

The fourth decisive step was the consideration of the criterion (a need, a value, an aim, etc.) around which a particular structure develops. The true organization of a group can be disclosed if the test is constructed in accord with the criterion around which it is built. For instance, if we want to determine the structure of a work group, the criterion is their relationship as workers in the factory, and not the reply to a question regarding with whom they would like to go out for luncheon. We differentiate therefore between an essential and an auxiliary criterion. Complex groups are often built around several essential criteria. If a test is near-sociometric, that is, inadequately constructed, then it discloses, instead of the actual organization of the group, a distorted form of it, a less differentiated form of it, an *infra*-level of its structure.

Within sociometric work several approaches can be distinguished: (1) the research procedure, aiming to study the organization of groups; (2) the diagnostic procedure, aiming to classify the positions of individuals in groups and the position of groups in the community; (3) therapeutic and political procedures, aiming to aid individuals or groups to better adjustment; and finally, (4) the complete sociometric procedure, in which all these steps are synthetically united and transformed into a single operation, one procedure depending upon the other. This last procedure is also the most *scientific* of all. It is not more scientific because it is more practical; rather, it is more practical because it is more scientifically accurate.

The Sociogram

The responses received in the course of sociometric procedure from each individual, however spontaneous and essential they may appear, are *materials* only and not yet sociometric facts in themselves. We have first to visualize and represent how these responses hang together. The astronomer has his universe of stars and of the other heavenly bodies visibly spread throughout space. Their geography is given. The sociometrist is in the paradoxical situation that he has to construct and map his universe before he can explore it. A process of charting has been devised, the sociogram, which is, as it should be, more than merely a method of presentation. It is first of all a method of exploration. It makes possible the exploration of sociometric facts. The proper placement of every individual and of all interrelations of individuals can be shown on a sociogram. It is at present the only available scheme which makes *the dynamic structure of relationships* within a group plain and which permits its concrete structural analysis.

As the pattern of the social universe is not visible to us, it is made visible through charting. Therefore the sociometric chart is the more useful the more accurately and realistically it portrays the relations discovered. As every detail is important the most accurate presentation is the most appropriate. The problem is not only to present knowledge in the simplest and shortest manner, but to present the relations so that they can be studied.

Numerous types of sociogram have been devised. A sample of the earliest type of sociogram* portrays the pattern of the social structure as a whole and the position of every individual within it. It shows the social configurations as they grow in time and as they spread in space. As the technique of sociometric charting is a method of exploration, the sociograms are so devised that one can pick from the *primary* map of a community small parts, redraw them, and study them so to speak under the microscope. Another type of derivative or secondary sociogram results if we pick from the map of a community large structures because of their functional significance, for instance, psychological networks. The mapping of networks indicates that we may devise on the basis of primary sociograms forms of charting which enable us to explore large geographical areas.

Concepts and Discoveries

Sociometry started practically as soon as we were in the position to study social structure as a whole and in its parts at the same time. This was impossible as long as the problem of the individual was still a main concern, as with an individual's relation and adjustment to the group. Once the full social structure could be seen as a totality it could be studied in its minute detail. We thus became able (1) to describe sociometric facts (descriptive sociometry) and (2) to investigate the function of specific structures, the effect of some parts upon others (dynamic sociometry).

Viewing the social structure of a certain community as a whole, related to a certain locality, with a certain physical geography, a township filled with homes, schools, workshops, the interrelations between their inhabitants in these situations, we arrive at the concept of the psychological geography of a community. Viewing the detailed structure of a community we see the concrete position of every individual in it, also, a nucleus of relations around every individual which is "thicker" around some individuals, "thinner" around others. This nucleus of relations is the smallest *social* structure in a community, a *social* atom. From the point of view of a descriptive sociometry, the social atom is a fact, not a concept, just as in anatomy the

*See J. L. Moreno "Das Stegreiftheater," Berlin 1923, pp. 90-100.

blood vessel system, for instance, is first of all a descriptive fact. It attained dynamic significance as soon as the study of the development of social atoms suggested that they have an important function in the formation of human society.

Whereas certain parts of these social atoms seem to remain buried between the individuals participating, certain parts link themselves with parts of other social atoms and these with parts of other social atoms again, forming complex chains of interrelations which are called, in terms of descriptive sociometry, psychological networks. The older and wider the network spreads the less significant seems to be the individual contribution toward it. From the point of view of dynamic sociometry these networks have the function of shaping social tradition and public opinion.

It is different and more difficult, however, to describe the process which attracts individuals to one another or which repels them, that flow of feeling of which the social atom and the networks are apparently composed. This process may be conceived as *tele*. We are used to the notion that feelings emerge within the individual organism and that they become attached more strongly or more weakly to persons or things in the immediate environment. We have been in the habit of thinking not only that these totalities of feelings spring up from the individual organism exclusively, from one of its parts or from the organism as a whole, but that these physical and mental states after having emerged reside forever within this organism. The feeling relation to a person or an object has been called attachment or fixation but these attachments or fixations were considered purely as individual projections. This was in accord with the materialistic concept of the individual organism, with its unity, and, we can perhaps say, with its microcosmic independence.

When we found that social atoms and networks have a persistent structure and that they develop in a certain order we had extra individual structures—and probably there are many more to be discovered—in which this flow of feeling can reside. But another difficulty stepped in. As long as we (as auxiliary egos) drew from every individual the responses and materials needed, we were inclined—because of our nearness to the individual—to conceive the tele as flowing out of him towards other individuals and objects. This is certainly correct on the individual-psychological level, in the preparatory phase of sociometric exploration. But as soon as we transferred these responses to the sociogram and studied them not singly but in their inter-relations, both to and from, important methodological reason suggested that we conceive this flowing feeling, the tele, as an

inter-personal or more accurately, as a *sociometric structure*. We must assume at present, until further knowledge forces us to modify and refine this concept, that some real process in one person's life situation is sensitive and corresponds to some real process in another person's life situation and that there are numerous degrees, positive and negative, of these inter-personal sensitivities. The tele between any two individuals may be potential. It may never become active unless these individuals are brought into proximity or unless their feelings and ideas meet at a distance through some channel for instance, the networks. These distance or tele effects have been found to be complex sociometric structures produced by a long chain of individuals each with a different degree of sensitivity for the same tele, ranging from total indifference to a maximum response.

A social atom is thus composed of numerous tele structures; social atoms are again parts of still a larger pattern, the psychological networks which bind or separate large groups of individuals due to their tele relationships. Psychological networks are parts of a still larger unit, the psychological geography of a community. A community is again part of the largest configuration, the psychological totality of human society itself.

Concluding Remarks

Once the sociometrists of both domains have arrived at a full consciousness of the deep divergence of their research situations, a common core of instruments and hypotheses may be worked out. (a) The sociogram as an instrument of exploration and presentation. Towards its further development each sister science can make a contribution. (b) The statistical measurement of actual social configuration based on the deviation from chance. A comparison of human, primate and mammalian groups on this basis should be fruitful. (c) Sociometric experiments with animal groups may present and solve problems which the human sociometrist cannot undertake. (d) The discovery of chemical agents which operate between individuals facilitating either mating or lethal effects, has opened up a fruitful line of research, as pointed out by Dr. Jennings in his study of Protozoa. In human inter-personal relations this angle has hardly been approached. Recent studies in *physio*drama of the socio-chemical correspondences to tele and the warming up process may mark a modest beginning in this direction. (e) According to Dr. Allee objective studies of non-human animals suggest that in the long run the group-centered are slightly stronger than the ego-centered drives. Cooperative experiments with human groups would gain in objectivity if sociometric principles would be applied

in their formation and direction. (f) As to the possibility of establishing a common frame of reference, may I pose the following hypothesis: Human and non-human social structures formed by actual individuals have a characteristic type of organization which differs significantly from structures which are formed by "chance" or by imaginary individuals. This has been proven for the human group by experiments, statistical and mathematical analysis. There must be a factor, 'tele,' operating between individuals, (for instance, in the exploration of appropriate mates) which draws them to form more positive or negative relations, pair relations, triangles, chains, quadrangles, polygons, etc., than on chance. A parallel process should be demonstrable for non-human groups as well. It is the inter-action of the individuals which gives the groups its social reality, whatever the hereditary forces are which direct individual maturation, and the environmental forces which surround them. Their influence is, of course, not denied, but they cannot operate by via the inter-individual channels. By this measure it is possible to determine the degree of social reality of the organization of groups. Certain social configurations have a structure which may place them nearer to the chance level, other social configurations may have a structure which places them nearer the optimum of cohesion. In accordance with this hypothesis, a group of primates or a group of human infants should rank lower on the scale than, for example, a group of human adults. There may be evidence available that such a factor as tele might operate more in certain species which show a comparatively great flexibility of inter-individual relations, but less in other species which tend towards rigid and hereditary social orders. There may be some usefulness in concepts as tele, social atom and psycho-social network as primitive means of communication at a distance among higher mammalian and primate societies. The papers of Dr. Carpenter, Dr. Scott and Dr. Montague indicate that such a convergence of approach, at least in methodology, can well be expected in the near future, drawing the two sociometries into closer collaboration.

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SHORT PAPERS

PSYCHODRAMATIC THERAPY FOR THE ALCOHOLIC

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The Psychodramatic Institute of New York City has recently inaugurated a project for the treatment of alcoholism which for the first time in the history of the therapy of this addiction takes full cognizance of the interpersonal and intergroup relationships implicit in the problem. Under the direction of Dr. J. L. Moreno it is our intention to bring to this subject all the resources with which his pioneering investigations in the fields of the psychodrama and sociometry have equipped us.

In accordance with sociometric principles the behavior of the alcoholic patient will be studied *in situ*. To the psychodramatic director this can mean nothing less than the controlled experiencing of actual alcoholic episodes and their consequences on the psychodramatic stage. Hence the stage will be at every moment transferable into a complete bar, adequately equipped with its bartender and its assortment of authentic liquors. Variations in spontaneity emergence, its vicissitudes and pathologies under alcoholic influence, will thus be subjected to objective clinical observation upon a rigorously controlled administration of the drug. Complete stenographic reports of verbalizations and actions should in time make available an illuminating yield of empirical data.

The etiology and treatment of the addiction to alcohol was hitherto been a subject of especial difficulty and some embarrassment both to the psychiatrist and the sociologist. Radical changes in legislation and mores have shifted and obscured the perspectives to a problem which in the past twenty-five years has been complicated by the inclusion of women and minors and the intrusion of fanatical minorities and the criminal underworld. In medical circles the psychoanalytic approach is regarded with growing favor, yet even in this once-promising field the prevalent insistence upon isolated and individualistic aspects of a problem so essentially interpersonal and intergroup has narrowed the theoretical prospect and with it the probability of further therapeutic advance.

The doctor-patient interview method is especially unsatisfactory in the treatment of chronic alcoholism. The sporadic entry into the situation of an arbitrary chemical variable deprives both physician and patient of any possibility of cordinated objective investigation. The physician is too often

forced, against his better judgment, into a more or less moralizing attitude, whereupon all decisive influence over the alcoholic patient is irretrievably lost. For the infinite gradations of public opinion on the subject of alcoholism —ranging from blanket condemnation, through hypocrisy into humorous tolerance—afford the patient a formidable repertory of collective attitudes wherewith to bulwark his resistance to whatever form of moral suasion his physician may see fit to adopt. The ensuing cancellation of role against counter-role is too often limited only by the time, patience and finances of the participants. An originally artificial relationship has thus become increasingly sterile; meanwhile the patient's real-life relationships, the actual foci of his difficulties, tend to be more and more disregarded.

We have every reason to expect that the study of our data from the sociometric viewpoint will provide us with a steady frame of reference toward those aspects of the drinker's social maladjustments which only the insistently mounting pressure of the psychodramatic process can reveal. It will now be possible to study *the alcoholic in action*—rather than through the reports of prejudiced obervers or the alcoholic's own distorted verbal symbolism—the progressive disintegration of the patient's former social atom and its gradual, insidious replacement by his new sociopathic atom, as well as the ever-changing interplay between the two.

As tested by Dr. Moreno with the aid of auxiliary egos in a number of cases, we should experience no difficulty in objectifying the changing tele processes from drink to drink, the heterosexual and homosexual role emergents, the recrudescence of superseded roles, e.g. the role of the child toward the bartender-father. These role-changes are so typical of the alcoholic that they are essentials of a truly adequate clinical picture, otherwise our knowledge of the effect of the drug on the specific patient would be wholly inferential. Of further interest would be the fluctuations in the drinker's auto-tele (revealed by reversal, double-ego and soliloquy techniques), his morning-after guilt-feelings, suicidal impulses and self-pitying extenuations. Finally the work-situation would be observed in psychodramatic demonstrations and reality-training techniques employed when sufficient therapeutic progress had been accomplished to warrant the hope that the patient's gains might thereby be securely consolidated.

Present at the sessions will be not only medical and lay students of alcohol addiction but such other alcoholics as can be expected to benefit by watching the drinker on the stage. Such an audience of participant-alcoholics will benefit by means of the well known phenomenon of audience

catharsis. When required many of them will step on the stage as actor-alcoholics, benefitting from an action catharsis.

As in all psychodramatic therapy, not only cathartic release, but motorically enforced self-observation, with its consequent spontaneous role-changes, will be supplemented by the carefully timed analyses of the director.

PSYCHODRAMA AS AN INSTRUMENT FOR DIAGNOSTIC TESTING

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A research group of the Psychodramatic Institute is at present conducting experiments designed to formulate and to standardize a simplified technique to determine the relation of an individual to his social environment, both peripheral and intimate. It is one phase of a wider rehabilitation program organized to help our returning servicemen as well as their families in their efforts to comply with the demands which an ever-changing reality imposes upon them.

Following a careful study of specific clinical tests as conducted by Dr. J. L. Moreno and by members of his staff, we have evolved a shortened, more flexible medium of procedure to be used in dealing with individuals or with groups when the time factor is of especial importance. The results obtained from our preliminary efforts support the theory that such a test is of value in enabling us to make a comprehensive classification of our subjects from which can be selected groups whose respective syndromes require specialized forms of psychodramatic therapy.

The test requires a minimum of three persons—a director who is well versed in psychodramatic procedure and two auxiliary egos, one male and female. A small stage is an added advantage, but good results have been obtained without its use. A recorder must, of course, be present.

The personality structure of a person can be largely determined by the degree of maturation with which he assumes his various life roles, and the emotional stability he achieves in carrying out the demands required of him by his social milieu. A short initial interview followed by a series of real life situations, chosen for the most part by the subject himself, is usually sufficient reality pressure to bring out material adequate for proper diagnostic evaluation. In this connection, however, we have found that the direction and focus of effort on the part of the subject may, at times, exert a centripetal force causing it to center itself upon one particular phase of interest. This we call the focal point of our test. When the subject who has been found to have a definite focus of interest is placed in a role or roles of lesser interest to him we call such roles extra-focal. It is in these roles that the analytical observer will be aware of a diminishing spontaneity, a slackening in the flow of energy, and a tendency toward role-lag (carrying over from one role to another). Our testing medium must, therefore, admit

of sufficient flexibility to allow amplification and expansion of such scenes as have a maximum amount of role-involvement for the subject.

In analyzing interpretively the material resulting from our test, we have discovered the importance of the inferences to be drawn—negative as well as positive—from the situations which are to the subject extra-focal. If it is remembered that the conscious separation of roles is an indication of maturation and integration of the entire personality, we must expect to find that an immobilization at one particular level will retard the development of spontaneous response to situations which should be well within the tele range of the individual.

The interview should be of the utmost informality. The psychiatric social worker's approach and environmental technique must be relinquished here in favor of a new method of inquiry and exploration. The open interview which is held just prior to the test has the following to accomplish: (1) To establish rapport with the subject. (2) To acquaint him with the procedure to be followed in the test. (3) To ascertain the necessary data for the record. *a*. Name, age, other siblings, or only child. *b*. Living with parents, wife or husband, alone, etc. *c*. Relationships with persons existing in his private world. *d*. Work or study situations, ambitions. *e*. Expand any subject-directed opening.

All of these facts must be drawn out at the same time the director is "warming up" the subject to his subsequent role portrayal. The success of the test will be in direct relationship to the degree of spontaneity the subject is able to bring to the real life situation he is about to create. He must be given "starters" throughout the interview to purge his mind of stereotypes and to bring into play his "s" factor (flexibility) in a swiftly moving crescendo.

There are various techniques devised and used by Dr. Moreno to "warm up" his subjects in the initial interview—active, inactive, parental, etc. The spontaneity of the director should enable him to select the method likely to prove most fruitful in a specific case. At some time during the interview he should have brought to light enough factors to guide him in determining the role into which he can place his subject with a maximum amount of cooperative compliance and the minimum loss of the spontaneity which has been evoked. It follows logically that the interview must merge with no loss of time into the predetermined life situation. During this process it is important that the auxiliary egos warm themselves up in order to attain the necessary degree of unity with the testee and to be ready to assume their roles when called upon by the director to do so.

From this point on the subject is placed into a rapidly developing series of life situations whose increasing momentum forces into expression many aspects of the subject's affectivity in intimate, occupational and cultural roles—aspects which might otherwise have remained merely potentials for good or for ill. Thus it can be seen that the test itself is not without its cathartic value.

It is not within the scope of this article to do more than indicate a simple outline of the diagnostic test. In a paper now in preparation examples will further illustrate the methods used in the selection of situations and the subsequent therapy.

ROLE-PRACTICE IN TRAINING DEPTH INTERVIEWERS

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It is axiomatic that the objectives of a study determine, in large part, its methodology—the kinds of data gathered, the instruments used in gathering them, the major emphases in analysis.

The present paper is a brief illustration of a very limited aspect of this relationship between objectives and methodology: training for depth interviewing designed to probe attitudes held by different ethnic groups in a low-income community.

The community under study is made up largely of three groups: Jews, Italians, and Negroes. It has had a history of recurrent outbreaks between Italian and Jewish boys. After the last clash, which took the form of a riot in front of a synagogue on Yom Kippur, the Commission on Community Interrelations was asked to undertake a study of frictions in the community and to inaugurate a program for overcoming them.

Fact-Finding and Action

The Commission had been set up to apply the techniques of social science to one of the great social problems of our day—improving relationships between ethnic and cultural groups, particularly Jewish-Gentile. It has a dual orientation: to probe the underlying causes of prejudice, and to carry out experiments in eliminating prejudice and building harmonious relationships between groups. The Commission recognizes these two aims not as separate activities but as two aspects of an integrated process of action-research.

To fulfill the Commission's objectives, then, the study of this community must provide not only a factual picture of the existing situation but an understanding of its dynamics: the forces producing tension and those tending toward harmony; and, again, how the former may be reduced, the latter strengthened.

Some of the necessary information could be obtained only by interviews that delved beneath the surface to dig out underlying attitudes, feelings, motivations. But that presented a fresh problem, for few interviewers trained in depth interviewing were available. A choice had to be made between

[1]Mrs. Schick is now Research Director of the Jewish Occupational Council. We wish to express our thanks to the other trainers, both on the staff of the Commission—Dr. Kenneth B. Clark and Mrs. Rose A. Cahan. Dr. Clark led some of the discussion sessions and Mrs. Cahan portrayed the three roles on which the discussions were based.

re-training fact gatherers experienced in public-opinion-poll techniques or training students who had no formal background in interviewing. It was decided that, for this particular job, inexperienced interviewers would be more easily trained, for they would have less to unlearn.

Choosing Interviewers

Criteria for the selection of interviewers were perfectly simple—flexibility and an interest in people. The selection narrowed down to six graduate students with training in psychology, sociology, and journalism. In racial and religious backgrounds they represented a variation that corresponded more or less to the community in which the interviews were to take place. There were two Jews, two Protestants, one Catholic, and one Negro. None, however, had any familiarity with persons of the socio-economic level represented by the group to be interviewed.

The next problem was basic. What would be the most efficient way to train these six young men and women for depth interviewing focussed on intergroup tensions in this particular community? Not only were the interviewers new to each other; they must learn to use a new instrument, a new technique, in a social setting that was new to all of them. Consequently, the training process must serve a double function. In addition to teaching the skillful use of the depth interview technique, adequate preparation must be given the interviewers for dealing with persons of varied backgrounds, viewpoints, and interests.

Basic Role Training

Five training sessions were held, each lasting two or three hours. The first was largely one of orientation, with one of the trainers briefly summarizing different types of interviewing and the appropriate use of each, explaining the purpose and philosophy of depth interviewing, and presenting a few simple basic rules for good interviewing.

Training proper began at the second session, with demonstration role practice carried on by the trainers. One trainer had an intimate knowledge of the three groups to be interviewed and considerable skill in projecting roles. She portrayed in turn a Negro woman, an Italian woman, and a Jewish woman. Three other trainers took turns in interviewing her.

These demonstration interviews gave the group of trainees a common frame of reference. As a result, subsequent discussion, usually brought forth some such observation as, "You remember how the interviewer gave Mrs. ——, as the Jewish woman, a feeling that she could give important information about the community."

On the basis of these demonstration role practice interviews, the group identified the following five roles that an interviewer may play:

a) Role of identification with the respondent;
b) Role of warm, sympathetic understanding person;
c) Role of the inquirer, the stranger, the person who wants to find out, the naive, the dumb, the person who is learning from the respondent;
d) Role of analyst, individual who is going to analyze these responses and answers;
e) Role of director in the action.

Role-Practice Interviewing

After this definition of an interviewer's functions had been formulated, the trainees began role-practice interviewing. Each one took a turn at being, first, the interviewer and, second, the person interviewed, the latter role being defined in terms of the kinds of people actually to be interviewed in the community. These role-practice interviews were accompanied by running comments by trainers and trainees alike as to the interviewer's effectiveness and the interviewee's understanding of the type of person he was portraying. Criticisms were specific; for example, "She got belligerent because you started asking questions too abruptly, without enough explanation of why you wanted to know."

Training then alternated between role-practice interviews and discussions of such technical aspects of interviewing as the use of probes, recording, and getting factual information. Each discussion was followed by role-practice in which that particular aspect was emphasized.

This combination of role-practice and discussion was continued until the trainees developed the ability to evaluate their own performances and sufficient familiarity with different kinds of responses that they could meet new situations with flexibility.

Going Into the Community

The next step was supervised practice interviewing in the community among respondents not included in the sampling to be studied. Because role-practice had so closely approximated real-life situations, the transition was smooth and the carry-over of training easy. A frequent comment was: "You know, that's just the way it happened when we were practicing, and —— was being the Italian woman. I wasn't quite convinced then that it would really work that way, but now I see."

The final test of the adequacy of such training, of course, is the amount and quality of the data gathered by the interviewers. By this measure, the training was successful. Most interviews were characterized by free and full responses; there were only three known refusals for 220 interviews.

For other types of interviewing, other training methods may be more effective. The writers feel that in this particular situation, the incorporation of role-practice as an integral part of the training process developed a degree of skill and insight that would otherwise have been gained only after considerable trial and error.

THE MEANING OF LAUGHTER IN THE PSYCHODRAMATIC AUDIENCE

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The phenomenon of laughter belongs to the most fascinating of manifestations of human personality. Any attempt to analyze the meaning and nature of laughter must have a broad psycho-physiological orientation. Anyone familiar with psychodramatic audiences will have noticed a prevailing tendency to laugh (a "willingness" to laugh) on the part of the audience. The response of laughter seems to be out of proportion to the humour contained in the situation when the same is analyzed objectively. Furthermore, a mood is observed present in the audience which can best be described by the term "hilarious". The audience leaves the session pleasantly relaxed; tired but nevertheless stimulated.

It is the purpose of this paper to develop an explanation for the behaviour of audiences in the psychodramatic theatre. Audience laughter has been formulated by Moreno as a manifestation of "audience catharsis". The situational stimuli presented do not warrant such major expenditure of energy which the great amount of laughter constitutes. This energy, therefore, must be derived (set off) from other sources. The impetus for it must come from within the organism; have an internal origin or reinforcement. The psychodramatic theory of spectator catharsis postulates that by witnessing the stage action the individual experiences a partial resolution of internal conflicts and elimination of tension. Perhaps, the mechanisms of this process can be hinted at by the phrase "the stage as mirror". It seems, therefore, that the energy expended in laughter has been released by the "partial resolution of internal conflicts and momentary elimination of tensions." The aforementioned observation concerning the relaxed state of audiences after sessions would also strengthen such a hypothesis. Of course, this author is aware that a validation of the process hypothesized would necessitate an exposition of the biological basis of laughter and catharsis together with a better understanding of energy expenditure.

RESEARCH-PROJECTS

RESEARCH IN "PHYSIO" DRAMA

LOUIS BERMAN, M.D.
New York City

Research No. 1 of the Physiodramatic Laboratory is concerned with the problems of the physiology and endocrinology of the "warming up" process of the psychodramatic technique.

It may be observed in the warming up process that different individuals vary as regards to the speed and intensity of starting and developing the inter-personal relationship on the psychodramatic stage.

That is, some are "cold" from the start and it takes them quite a while to "warm up" while others get "hot" almost immediately with, of course, transitional types of various kinds. In these reactions the individual exhibits his type—the "cold" type generally finds it difficult to get started with people while the "warm" type finds it relatively easy and simple.

It is desired to relate these different types of reaction to the autonomic and neuromuscular systems and to the hormones and hormone-like substances which influence the response threshold of these systems either way—raising or lowering it. These must naturally be the ones which produce a relatively rapid effect so that a comparison can be made at the same psychodramatic session of the pre and post effects. Those which can be administered orally will be given first, and then those which have to be given hypodermically or intramuscularly with merely passing effects. All precautions necessary will, of course, be taken to maintain the proper controls.

At the same time a standardized "rapid" Rorschach test will be done before and after and a correlation with the hormonal and psychodramatic data attempted—the comparative effects on W, M, C and D are the reactive methodology being studied.

SOCIOMETRY IN THE CLASSROOM

NAHUM E. SHOOBS
Public School 157, Brooklyn, New York

In our current research project we will present the use of sociometric tests and the resulting sociometric group organizations; on the basis of these findings we plan to help our pupils to arrange their work and social relationships and to learn to control external circumstances. These principles will be applied to several groups whose leaders have outlived their usefulness

to the group. Through actual living and not through discussion and interpretation, these children are meant to establish desirable interrelationships and to accept responsibility for their decisions.

Tables of pupil choices for workmates and friends will be presented. We will attempt to show the relationship between work group organizations and those of friendship groups. Such tests and tabulations will disclose many problems, some in *statu nascendi,* many of which we might not have uncovered until long after they have become deep seated and difficult to correct. In this manner it is possible to combine sociometry with guidance.

We will give some particulars of our training in social feeling and interpersonal relations, as for example, leadership development, social adjustment, devices to aid isolates and rejectees by seating arrangements, committee appointments, assignment to other classes, teachers and promotions.

We hope thus to provide teachers with a simple instrument for teaching social relationships in the classroom.

PSYCHODRAMATIC APPROACH IN VOCATIONAL GUIDANCE

LEONA M. KERSTETTER
New York University

Psychodramatic methods will be applied in a vocational guidance program for youth at a settlement house in East Harlem, which is located in a predominantly Italian neighborhood. A Consultation Bureau directed by guidance personnel will apply the findings of personal interviews to a psychodramatic guidance program for problems of vocational adjustment, such as: how to apply for a job; how to act in the interview for a job; how to act in the job situation; how to approach one's superior, how to cooperate with co-workers, etc.

ANALYSIS OF PSYCHODRAMATIC DIRECTORS

ALBERT S. INGALLS
Psychodramatic Institute, New York City

In "Developments in Social Psychology" Leonard S. Cottrell, Jr., and Ruth Gallagher write:

"One of the chief disadvantages of psychodramatic work as it has been done to date is that the more subtle aspects of the experimenter's activity have remained buried away from outside observational check. The preliminary role taking he does in order to set up a critical experimental situation, the way he uses his past experience with or knowledge about a particular subject when analyzing that subject's behavior on the stage, have remained hidden as parts of his covert behavioral processes. If social psy-

chologists are to turn the experimental psychodrama to any better operational use than the clinical investigator, they must devise techniques that will bring these covert processes out into the open. One technique that suggests itself is to put the director himself on the stage in a situation he wants to analyze, letting him soliloquize as analyst while he participates in the interaction."

This statement presents a very interesting criticism. It is a criticism that also presents many difficulties.

A psychodramatic director does his finest work in a state of complete spontaneity. It is doubtful if he could tell why he did certain things. Afterwards he could rationalize his actions, but that would not explain them.

The soliloquy technique would reveal certain phases of direction, but this technique, when used in interaction, has the tendency to keep a person away from the spontaneity state.

In order to bring the covert processes of direction out into the open three different directors, Dr. J. L. Moreno, Dr. Bruno Solby and Miss Frances Herriott, will be analyzed in action.

PSYCHODRAMATIC RESEARCH OF PRE-MARITAL COUPLES

ZERKA TOEMAN
Psychodramatic Institute, New York City

1. Separate interview of twelve pre-marital couples is to be undertaken.
2. The interview material will be broken up and a system of scoring applied. The score will involve prediction of chance for success.
3. Certain typical situations which occur in all cases will be projected upon the psychodramatic stage by the couples themselves and by auxiliary egos, working out a number of possible variants of these situations.
4. A system of scoring is to be applied to the couples after psychodramatic presentation of their relationship. Here also the score will include prediction of chances for success.
5. The prediction of chances for success to be based on the interview material, compared with the prediction of material gained by the psychodramatic method.
6. The twelve couples will be followed up at regular intervals and the predictions compared to actual developments.
7. The purpose of the study is to determine where prediction made on the basis of interviewing and on the basis of psychodramatic procedure overlap or differ and which of the two methods predicts success or failure more accurately.

IN MEMORIAM

RICHARD FIRESTONE

1888-1944

Dr. Richard Firestone, a gentleman and a scholar, passed away on the 5th of September, 1944, in New York City, as he was about to return to his Winter Park home in Florida where he had lived since 1921. To the very last he was active, he was writing a book on Elizabethan literature. He was a pioneer in education, using methods of teaching, the significance of which will rise in years to come.

Dr. Firestone was born in Austria, November 11th, 1888. He graduated from the University of Vienna, Austria, in 1921 with the degree of Ph.D. He studied German language and literature, Romance languages and literature, and dedicated his Ph.D. thesis to the title "Friedrich Hebbel und die Stuermer und Draenger." He carried on with his postgraduate studies at the Sorbonne University and finished an important study there "Les Theories Dramatiques de Louis Sebastien Mercier." In 1915 he accepted a position at a Viennese college where he taught until 1920.

It was in this year that Dr. Firestone made the most important decision of his life. Greatly disillusioned by the moral and social conditions which prevailed in the old country during the postwar period he resigned his position and left for the new world. On the steamer he met Augusta Holland who became his wife soon after he arrived in the United States. Dr. Firestone was, after a short time of fellowship at the University of Pittsburgh, appointed in September 1921 as Professor of Modern Languages at Rollins College, Winter Park, Florida. There he taught Greek, French, German, comparative literature, while possessing a working knowledge of Latin, Spanish and Hebrew. It is to the students of Rollins College that he gave the best part of his pedagogic idealism, a philosophy and method of education which was an inspiration to all who came in contact with him. Hundreds of students in all parts of this world mourn the passing of their teacher.

Although he paid little attention to official recognition, he received a decoration of honor from Rollins College in 1935 for distinguished service. In his leisure time he was engaged in extensive research. His book on

Renaissance and Elizabethan literature aroused great interest. Professor Carlton Brown of New York University wrote: "I believe you have made an important contribution to the interpretation of a considerable body of Elizabethan literature." Dr. Firestone was one of the first to apply psychodramatic methods to education and wrote a brilliant treatise on Soren Kierkegaard, which was to be published as a Psychodramatic Monograph, as was planned a few days before death took him from his unfinished work.

Dr. Firestone has left a wealth of unpublished manuscripts behind, which a future biographer must consider in order to acquaint himself with a life spent in creative thought. A sundry enumeration of their titles suggests his encyclopedic range of interests: The Literary Character of Robert Chester's "Love's Martyr: or, Rosalins Complaint," of the "Cantoes," and of the Poems "Done by the Best and Chiefest of our Moderne Writers"—An Introduction into the Central Problem of Elizabethan Literature; The Literary Character of Robert Parry's "Sinetas"; Sapientia Socratica Joco-Seria—An Inquiry About the Serio-Comic Socratic Wisdom in Ancient Classical Literature; Rosalind, and the Mystification of Male-Female in Elizabethan Literature; Gabriel Harvey's "The Schollars Loove, or Reconcilement of Contraryes . . . An Amorous Odious Sonnet . . ."; Shorter studies on: Drummond of Hawthorndon, Seven of Shakespeare's Plays: Love's Labours Lost, As You Like it, Measure for Measure, All's Well that Ends Well, Twelfth Night, The Winter's Tale, Cymbeline.

It was a mystery to many who knew him, why a man with Firestone's great creative energies was not able to channelize them and to turn them into visible, social success, and why so many lesser lights surpassed him. To me the key of explanation is in a rigorous idealism and perfectionism modelled after Kierkegaard's philosophy of private, personal existence. As he resented fragmentariness of thought, he developed a phobia against premature publication. He preferred to enshrine his thought and sentiment into living beings, his wife and children, the circle of his friends. He had resigned himself to a sociometric form of immortality, to be remembered by a few intensively, rather than by a great many vaguely.

J. L. Moreno

BOOK REVIEW

The Peckham Experiment, A Study of the Living Structure of Society, Innes H. Pearse, M.D. and Lucy Crocker, B.Sc. Published for the Sir Halley Stewart Trust by George Allen and Unwin, Ltd., 40 Museum Street, W.C., London. 12s. 6d. 1943.

Probably as far back as records go men have regarded illness as due to the presence of some harmful factor in the man who was ill. At first it was a devil or devils who had to be cast out before the man could be restored to health. Later it became humors. Then bacteria or poisons. Drugs, medicines, and treatment generally had as their purpose the neutralizing or counteracting of the effects of these harmful things. Even as late as the opening of this century, a disease such as scurvy was thought to be due to the presence of some poisonous factor. A similar view was taken of beri-beri. Eijkman concluded, in accordance with the view of disease prevalent in his time, that foods, such as rice, overrich in starch, produced in the intestine a substance which acted as a poison to nerve cells, for which the outer layers of the rice grain acted as an antidote. Later another Dutch worker, Grijns, in 1901, interpreted the facts differently and created a revolution in medical theory by suggesting that beri-beri was due to the *absence* from polished rice of an essential nourishing factor. (Later identified as vitamins.) The classical biological experiments of Hopkins in 1912 laid the foundations of the current view that many diseases are due to the *absence* of specific factors required for health rather than to the presence of harmful factors in the body of the sick person.

In this book, a biologist and a physician who is a specialist in endocrinology, both with training in sociology and education, suggest that a similarly revolutionary view be taken of the causes of the social illnesses, maladjustments, and problems of modern society. The prevailing view today is that these are due to the presence of certain harmful factors: congestion, overspecialization in work, the factory system, capitalism, poverty, exploitation of the workers, bad housing, urbanization, extreme disparities in income, conflict of cultural heritages, etc. The cause varies with the reformer propounding it. As a consequence, reform movements for one hundred years have been organized to "cast out" one or another of these factors. Marxists want to rid the world of capitalism and exploitation, housing experts to outmode congestion, industrial decentralizers to make urbanization a thing of the past; incomes taxes, social security payments and government pensions are to counteract difference in income; Americanization programs,

"reconciliation" projects, and the teaching of tolerance are to cure cultural conflicts, and so on.

These two Engishwomen, however, bringing to bear on social problems the severe discipline of biological science, advance the hypothesis that certain crucial ills of modern life in industrialized countries are due, not to the presence of these or other harmful factors, but to the *absence* from our environment of factors essential to enable the mass of individuals who make up our populations to attain functional efficiency. These factors they identify as instrumentalities through which the family can fulfill its indispensable vital function of nurture. They contend that as these do not exist and as the growth and development of human beings demand them, such instrumentalities must be invented and must become living structures in the society of the future. Like industrial engineers who, seeing a need, feel compelled to invent a machine to perform in a specific way to meet that need, they invented the Pioneer Health Centre in London in 1926, to meet certain biological necessities of which the family had been deprived in the course of the industrialization of society, necessities only now beginning to be understood fully by science. Again like their industrial prototypes, they subjected their invention to rigorous tests and kept careful records of its performance. *The Peckham Experiment* is the first of two volumes in which these will be summarized, and follows two previous publications which traced the various preliminary explorations which led to the invention.

The invention is a social structure in which "families can find equipment for the exercise of capacities for which there is little or no outlet in the ordinary circumstances of their lives" (p. 13); in which they "are free to act voluntarily rather than in conformity to any predetermined conduct, in pursuit of any (imposed) ideal or in response to any external discipline"; which "contains a maximum of diversity", with "adequate chances to exercise volition so that their biological potentialities become explicit in the ordinary circumstances of living"; providing the "requisite social contacts permitting diversity of action by the families" (p. 41).

These requirements are not determined by any nostalgic yearning to "save the family", nor merely by way of making family life more agreeable, but because as biologists they regard the family as Nature's *"instrument for the cultivation of functional efficiency"* (p. 122), a term which subsumes physiological health, full development of the capacities and abilities of the organism, and functional coordination adequate to meet *spontaneously* the demands of living in any particular environment. The authors' researches and experiments have convinced them that these ends can be most eco-

nomically attained by providing the conditions to enable the family, "integrated within itself and with society, to serve as the formative and synthesizing factor in education" (p. 122). They believe that a population composed of fully developed individuals will create a healthy society, one capable of curing itself of many of the ills from which we now suffer. It must be done, however, not by direct training of the individual, but by building social structures on the family as a unit.

It is worth underlining that these conceptions conflict sharply with those which have patterned contemporary, conventional, formal and informal educational activities characteristic of the United States. As a critique of our practises, this book therefore reserves careful consideration. Here our official social agencies, private and public schools, Christian and Hebrew Associations, youth-serving, recreational and adult education institutions rely in the last analysis upon "knowledge purveyed by training" (p 122) to enable individuals to attain competence. More and more such agencies take responsibility for mobilizing individuals by age groups and detaching them from their family, neighborhood, and other group-relationships. The "teen-age canteens" now advocated so ardently as preventives of juvenile delinquency are a case in point. What probably saves our society from complete disintegration as a result of the official policy of these agencies is that the private ones touch no more than two to five per cent of the population, and that various compensatory, corrective measures, or "culture conserves" offset to some extent the damage done by the public schools.

If the studies of these two biologists reveal typical conditions, it is difficult to evade the conclusion that the vast majority of the members of our society fail to achieve anything like functional efficiency. Health examinations, given to nearly 4,000 "normal" individuals of all ages, members of the Health Centre, showed 32% suffering from disease, 59% apparently well but actually burning up their reserves to compensate for disorders, and only 9% with neither disease, disorder, nor disability. Moreover, all but an infinitesimal percentage of the total number lived on a plane of inactivity, apathy, or "rude impetuosity", lacking the ability to digest experience, representing arrested or unbalanced psychological and social development (pp. 120-22).

It is the causes of such a situation that these biologists wish to attack and they are convinced that the first step is to base all educational efforts on the family as a unit and not upon the individual. The next step is to free the family from any compulsion to follow predetermined programs; to afford it the maximum opportunity to exercise volition, choice, spon-

taneity; and to provide it with an environment sufficiently fluid to enable all the experiences available—mental, physical, and social—to be made use of, not necessarily in the conventional and accepted way, but *according to the growing needs and capacity of each family as it develops* (p. 45). As a consequence, the building in which the Health Centre is housed was ingeniously designed to stimulate spontaneous action. No deliberate methods of organization whatever were used. No action resulted from professional leadership, but "arose spontaneously out of the circumstances of the environment freely impinging on the families as they used the Centre." To these basic techniques the authors give credit for the results the Centre obtained: constantly mounting creativity among the members, heightened zest for life, readier assumption of responsibilities, more independence of thought and action, and improvement in physical health as well. These results were checked not only by continuous observation of the behavior of the members, but actually were registered in the comparative records of the periodic health overhaul which was one of the privileges of membership in the Centre and served also as a specific criterion to evaluate results.

With reluctance one notes some weaknesses in a book otherwise distinguished for clear and careful reasoning regarding a project arising out of creative use of the scientific method. It is only fair to point out that nowhere have the authors made explicit the *psychological* implications of their theory that the family integrated within itself and with society develops human potentiality, health, and competency. Biological support for the theory is regarded as sufficient and much valuable insight is in consequence given the reader into the nature of the relationship of mutuality and synthesis between human beings and their environment. However, aside from a brilliant analysis of mating, the book lacks any fundamental analysis of the nature of human relationships, which constitute for modern man a preponderant element in that environment, of the nature of the dynamic forces which they set in motion, and of the perhaps definitive role they play in the development of human personality.

One cannot help but feel that familiarity with the body of sociometric theory, spontaneity theory and psychodrama would have brought to bear on this and other phases of the authors' experience considerations which would greatly have illuminated it for them and for the reader. Although the family unit occupies an impregnable strategic position in society, it fulfills its nurture function by making use of the same dynamic factors which obtain in all human relationships. It is, therefore, the fact that it is a nexus of relationships which gives the family its importance as a social

unit—not merely its biological performance and the formal functions our society has assigned to it. Additional weight is given to this observation by the facts gathered by anthropologists regarding the great variety of family structures discovered in primitive cultures around the world. Their function is always the same: nurture; but often this responsibility is carried not by the immediate biological parents but by relatives who stand in *loco parentis*. It is obviously the *relationship* which is the definitive factor. The authors themselves are the first to point out that birth can be a mere accident and that the family in which relationships are not cultivated, a family with no strong understanding of its role of nurture, constitutes a devitalizing and sterile environment. It is, therefore, *relationships* about which the authors are talking throughout the book and its usefulness would have been greater had this fact been made more explicit.

One wishes also that the authors had discussed in more detail the contribution made to functional efficiency by inter-family and non-family relationships. One is struck over and over again by the fact that such relationships played an indispensible role in the success of the project, but this fact is not specifically emphasized and hence a finding of the utmost significance is likely to be lost on the average reader. All the observations regarding behavior in the Centre would have been sharpened had the authors been aware of sociometric methods and interpreted their findings from the psychological as well as biological point of view.

A third weakness in the book is the lack of any specific discussion of the spontaneity factor. Although the authors admit that they depend upon spontaneous action to organize and carry on Centre activities, they appear to have no adequae theoretical understanding of why it is so important a factor in creating order, releasing capacities, and heightening vitality. Here again, knowledge of Dr. Moreno's penetrating analyses of the role of spontaneity in creativity would have made this aspect of their enterprise far more illuminating to the reader.

Maria Rogers
New York City

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MARCH, 1945

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ANALYSIS OF SOCIOMETRIC POLL

Officers and Counsellors of the American Sociometric Association

The sociometric techniques of organizing an American Sociometric Association, as proposed by J. L. Moreno in Sociometry, Volume 7, Number 4, November 1944, have been put into operation and the following results have been obtained.

Membership: 100

Participation: 74.7% of the ballots mailed out were returned, properly executed

Officers Chosen:

President: J. L. Moreno—64% of incoming first choices, total score 219 points

Secretary: Helen H. Jennings—total score 184 points

Treasurer: George A. Lundberg—total score 90 points

Counsellors: Gardner Murphy—total score 64 points
Ronald Lippitt—total score 64 points
Zerka Toeman—total score 63 points

Score Value of Choices: First choice—4 points; second choice—2 points; third choice—1 point; team choice—1 point.

Since the last report of 84 members 16 additional members have been admitted by the Temporary Committee, 97 of whom were admitted in time to take part in the voting. Six members did not participate in the ballot because of being overseas. Of the 91 actively participating in the ballot 71 members received choices for one capacity or another. One or more first choices for President have been received by eleven members: Moreno, Lundberg, Jennings, Murphy, Lazarsfeld, Lippitt, Solby, Murray, Newcomb, Frank, Chapin. Fifty-five different teams have been chosen. The most frequently chosen was team (4) Moreno-Jennings-Lazarsfeld. Within these fifty-five teams, the most frequently chosen team-pair was Moreno-Jennings (12).

The country-wide poll has been analyzed according to those geographical regions, in which choices were more frequent. Twelve regions have been differentiated and the highest scores for each region calculated. First region, California, highest score Farnsworth (5); second region, Canada, highest score Northway (11); third region, Washington, D. C., Solby (28), Herriott (24) and Murray (19); fourth region, Illinois, Burgess (11); fifth region, Michigan, Newcomb (35), Loomis (18); sixth region, Minnesota,

Chapin (14); seventh region, New York City, Rogers (51), Lazarsfeld (41), Frank (25); eighth region, New York State, Spence (28); ninth region, Ohio, Toops (6); tenth region, Texas, Criswell (47), Bonney (10); eleventh region, Wisconsin, Becker (16); twelth region, Syria, Dodd (11).

An analysis of the *first choices only* showed that the six members of the Executive Committee polled as follows: Moreno 209, Jennings 164, Lundberg 61, Murphy 32, Lippitt 30, Toeman 60. It appears that the same committee would have been chosen if only *one* choice would have been permitted to the members. But there would have been total ignorance or dislocations of lower scores in the various regions differentiated. A check up was made of who chooses whom, from the point of view of their affiliation and function, whether, for instance, professional sociologists prefer each other, professional psychologists, or professional therapists, prefer each other. A remarkable *absence of cleavage* was noted which spoke well for the internal consistency of sociometric interest, as surpassing all other motivations. Although motivations for choice were not requested, it appeared clearly that choice was given for capacity and prestige rather than for other reasons, for instance, because of friendship. Friendship cliques could be noticed—and it is a phenomenon to be expected to come forth in sociometric analysis—but they were minimal considering the natural temptation to choose a friend rather than a qualified person. This is borne out for instance, by the following data: 25% of the choices received by Moreno as first choice for President came from members who are not acquainted with him and with whom he is not acquainted. More than 20% of those who have chosen Helen Jennings are not acquainted with her, nor she with them. More than 30% of the people who chose Lundberg apparently did not know him, and he does not know them.

The choice process can be analyzed as to the number of choices received (1st, 2nd, or 3rd), the number of points accumulated, and the number of individuals choosing a particular member. Moreno was chosen by 50 members, Jennings by 49, Lundberg by 30, Murphy by 30, Lippitt by 22 and Toeman by 18, for different offices. The range of influence is at times better expressed by the number of individuals choosing a member than by the number of points accumulated.

Another aspect which shows up significantly in this poll is *the value of a choice*—its quantitative value and its "role" value. In order to portray this adequately we would have to have the permission from all members of the society to name, not only the choices received, but also the choices given. In the present analysis we adhere strictly to quoting only the names

of people who have *received* choices. The choosers remain anonymous. But we know from sociometric studies that fifty choices received may, in terms of actual influence, be less than five choices from certain individual members who themselves are receptors of a large number of choices. A member may receive a quantitatively large number of choices and be elected for office, but the choices may come from comparatively insignificant members, that is, as to the number of choices they themselves receive. Another member may receive a small number of choices and *not* be elected to office, but the choices may come from members who are themselves receptors of a large number of choices. There is here obviously an imbalance which should make an interesting research project—as to how to correct this imbalance, or whether we should leave this imbalance *consciously* uncorrected. We are emphasizing this point here as there is in sociometric literature often a confusion between what constitutes a popular individual in a group and what a leadership position. The *dynamic structure of relationships* is the decisive point and not the number of choices received or given. This comes to expression also in what we have called the role value of a choice. When polls are undertaken for the election of capable individuals in a particular field of endeavour a single choice from a member who is a generally recognized authority in this field, but who otherwise is himself entirely unchosen, may weigh more heavily than the choices or fifty beginners in the field.

A number of valuable comments have been received from members as to how the technique can be further improved.

Comment from Joan H. Criswell: In voting for officers I was influenced by the geographic distribution of members, as I feel that especially at this early stage the officers should be able to meet and confer frequently and should also have the greatest possible opportunity to contact personally the other members. Since the largest body of members is located in the East, I confined my selections to this area except when choosing the team that I personally would work with. In the latter case I chose without regard to location because I am so distant from other members that I would invariably have to confer by mail. Probably I was not the only member to choose with geographic distribution in mind. Another factor of importance in interpreting the results would be the number of members whom each voter knew personally or through published work. It would probably have been a good idea to have each chooser double-check in the member list the names of the persons he was acquainted with, single-check those he knew only through their work, and also add a brief statement of the bases of selection he used, returning the list of members with his ballot.

Comment from Jack S. Morrison: It has been observed that we west of the Mississippi are rather sensitive about the geo-political nature of national organizations. There is no question in my mind but what this organization's center should be in or about New York. Let's see, however, if sociometric principle can beat this cleavage, an unsolved problem in the professional societies I know.

Comment from Read Bain: (In regard to Choice according to Preference for Co-workers) Not clear—should read: If I were chosen President, I'd choose for Secretary . . . for Treasurer . . . and so on for the other two offices. Makes considerable difference whom one would choose if he were chosen for anyone of the three offices.

Members of the society are invited to contribute their comments as to how the sociometric technique of election can be modified and refined. We will try to incorporate their comments and suggestions into the next sociometric ballot.

IDEAS AND PLANS FOR THE DEVELOPMENT OF A SOCIOMETRIC SOCIETY

J. L. Moreno

The American Sociometric Association is to be an experiment in society-creation. Instead of studying the structure of an already existing society, its institutions, the character of its people and its social pathology post mortem, one can concentrate on creating new societies with institutions of an original order, checked and controlled from step to step, as they develop from the present into the future.

The members of this society, by the very act of electing its officers, have elected themselves as members into the society. By doing this, the society itself has come into existence. This is as it should be. It is a society *sui generis,* the first of its kind in the history of civilization. It is not an "experiment of nature" showing, after a period of unconscious development sociodynamic regularities. It is not the act of one mind or the decision of a few founders. It is the conscious, social act of its total present membership, creating the society and becoming members of the society by means of this act.

The formation of this society may be considered one day as a political deed of the first order, its membership should succeed to maintain consistently its sociometric and self-propelling character. The open implication of

the experiment is that what is possible for a little social cosmos of one hundred, should be possible for a group of any size. In order to keep from the very start full scientific control of the development of our society, we must vigilantly consider every factor which enters into its formation, fully conscious that every decision which we are making as a group may have beneficial or fatal consequences for the future destiny of the society.

Let us consider therefore, the elements which we have already thrown into this society in formation. In the first place, in order that the society can define itself, we have introduced an instrument suitable for self-finding, self-exploration and self-decision—the sociometric procedure. As it is planned to use this instrument repeatedly, every time the group is to make a significant choice or decision, the sociometric procedure must be considered as the *first social institution* which the society recognizes and permits to establish and perpetuate itself. The acceptance of the sociometric instrument has not taken place blindly but is the result of many years of study by a large number of sociometrists. The degree, of course, to which the sociometric instrument will be used, would depend entirely upon the society's total membership from time to time. It will depend on the degree of sociometric consciousness, the dynamic structure of its groups which it will permit to come into operation on the surface.

Membership Criteria

The abstract membership, characteristic for many scientific societies, should be replaced by a type of functional and concrete membership. The criterion of a member should not be what he is to the society in abstract terms, but what he can produce for it because of his scientific capacities and the contributions he makes to the community in which he lives. The criterion of membership should therefore be based on *the role in which a prospective member is most productive.* One may be most productive because he is a researcher, another because he is a scholar, a third because he is a teacher, a fourth because he is a practitioner. In the community at large individuals who function in various roles, as physician, lawyer, artisan, or minister, may have earned the full respect of their fellow men *each in his own capacity.* However different their prestige status may be, their status as specialists is fulfilling a community need of equal rank. An exchange of service is continuously going on in the community to the benefit of all. In this sense a sociometric society should not limit itself to the admission to membership of persons with an academic degree, but permit individuals of all types to become members if they can make a contribution, in a particular role. There

should be many categories of membership, as related to a concrete field of operation, each with a different *role-character*. A member is then not a member in an abstract sense, but in the role-character in which he is chosen. When, for instance, applicants for membership are presented before the society, they would not apply to become members in *general*, but in reference to a specific criterion and role. Dr. A for instance, has made a contribution to the group organization of industrial units. He has no connection with a university and therefore does not function in the role of a teacher, his scholarly aptitude is average, or small, he is primarily a researcher. If his membership is accepted, he is accepted into membership category R, within the area of research. Another member may be admitted because he is a teacher of sociometry in a university. He has never made any contribution to sociometry, he is admitted as member in category T. Aonther may be admitted as fulfilling both criteria, researcher and teacher. He will then be admitted as member in category R and T. Another applicant may be admitted because of his contribution to the historical development of sociometry and also because of being a teacher and researcher, he will fall into the category of R, T, and S. Another individual at last, may have no degrees, but may be employed in a large industrial concern and engaged in applying sociometric principles to his work situation, he is a *practitioner* —P. He may be admitted as member in reference to the criterion P. In this manner *the society will be divided and sub-divided into several operational areas*. Into each area will fall members of each of the categories enumerated above. New operational areas could be added to the ones mentioned, certain members will fall only into one area, some in two or three, and perhaps some in all. The operational status of a member will be clarified by the initials following his membership, for instance, R, S, T, or P. Sociometric tests will disclose association between *like* individuals and roles and natural cleavages between one or another group within the society. On the other hand, on many occasions we may see that members of various operational areas might cooperate in certain committees and tasks. We may then see an exchange of influence taking place between the practitioner and the researcher, the scholar and the teacher, and so forth.

Division of the Society into Regions and Local Units on a Sociometric Basis

The society will be sub-divided into regional and local units, the chairman of that unit being that member which has shown the highest score in the sociometric test procedure just taken. For instance, Dr. B may not

have been chosen for the Executive Committee at large, but shows the highest scoring for Oklahoma, Texas, etc. In the District of Columbia Dr. C. may have shown the highest scoring although he is not elected for the Executive Committee. He would therefore be the logical sociometric chairman for the Washington, D. C., region, and so forth.

Active Participation of Members in Forum of a Sociometric Test

Every member is to contribute an annual paper on a research project in progress. The journal SOCIOMETRY has agreed to reserve for every member the space of 300 words. These projects will be published in SOCIOMETRY or in special issues thereof. All members are invited to send in the problem area of their research which will be listed regularly in current issues of SOCIOMETRY. Such members who do not have any project in mind, may assign their printing space to another member whose topic they favor. This will be carried out like a sociometric test, certain focal topics and focal members may receive the major share of space from the members. The space which these most chosen researchers will receive will be in proportion to the quantity of choice received.

The result is that the research space which the society provides for publication to its members will be stratified in accord with the status which a member has attained among his fellow members. One may receive fifty times three hundred words, because fifty members have considered him as particularly qualified and his topic particularly significant and have assigned their space to him. Others may receive only ten times 300 words, some may not have received any space from others, but use the space of 300 words allotted to them. Some may give their space to others and not use it themselves. Finally there may be some who might not use their space but also do not choose to give it to others. The result will be a sociogram of which the criterion will be the numbers of words given or received. As a matter of principle such members who do not participate will cease, in the course of years, to be members of the society automatically. The professional status and the paying of dues should *not* be considered sufficient for maintaining membership.

The manuscripts of the one hundred Research Projects (one hundred members) should be in the hands of the Editors of SOCIOMETRY latest by December 31, 1945, covering a minimum of 30,000 words.

Constitution and By-laws

A constitution and by-laws are being prepared and will be presented to

the members for consideration. Meanwhile new applications for membership are received and considered, the final decision to be made after criteria for membership to the A.S.A. have been established.

A Three Year Plan

Since sociometric activities began to spread in the United States almost fifteen years have gone by, and thousands of active workers have been influenced by its principles. If during the next three years these potential members could be activated, a large sociometric society could be established in this period.

ANNOUNCEMENTS

American Sociometric Association, Officers Elected, 1945-6

President: J. L. Moreno; Secretary: Helen H. Jennings; Treasurer: George A. Lundberg; Counsellors: Gardner Murphy, Ronald Lippitt, Zerka Toeman.

University of Denver, Psychodramatic Institute

A Psychodramatic Institute will be held at the University of Denver, summer school, from June 18th to July 20th, under the direction of J. L. Moreno, M.D. The project is sponsored by the School of Education, Psychology, Social Work and Speech.

Massachusetts Institute of Technology, Research Center for Group Dynamics

A Research Center for Group Dynamics has been established at the Massachusetts Institute of Technology as a division of the Department of Economics and Social Science. Dr. Kurt Lewin, formerly professor of psychology at the State University of Iowa, has been appointed director of the new center.

New York University, Course in Psychodrama and Sociometry

A two credit course in psychodrama in sociometry will be offered at New York University in the School of Education during the academic year beginning September 1945.

This course will deal with the historical background of these methods as they have been developed by Dr. J. L. Moreno. The spontaneity theory of child development and the psychodramatic and sociometric approach to the study of the dynamic structure of natural groups beginning with the nursery group will be discussed.

Opportunities for research in the use of the sociometric test and the spontaneity test will be provided. The concepts and theory basic to the understanding of the psychodrama and sociometry will be introduced and the application of these methods in specific areas such as—the public school, the prevention of delinquency, leadership training, marriage problems, family situations and rehabilitation.

An important part of the course will be the opportunity for observation and participation in demonstrations of the psychodrama by Dr. J. L. Moreno at the Psychodramatic Institute at 101 Park Ave., New York City.

Anyone who may wish further information may write to the instructor,

Miss Leona M. Kerstetter, 41 Press Building, School of Education, New York University, Washington Square, New York City.

University of Puerto Rico, Social Research Center

At the January meeting of the Superior Educational Council of the island, the Council indicated its approval in principle of a memorandum submitted by the Chancellor, calling for the initiation of a social science research center to be established the 1st of July, 1945, and the Council furthermore indicated that the suggested non-fiscal year appropriation of $360,000 for the 3-year period until the 30th of June, 1948, seemed suitable, subject to more detailed estimated to be submitted in May. The Chancellor indicated to the Council his designation of Lewis A. Dexter as Special Advisor on the planning of this center.

Veterans Rehabilitation Center, Chicago, Applies Psychodrama

Psychodrama is being used in the Veterans Rehabilitation Center, Chicago, under the clinical direction of Dr. Alfred P. Solomon, for helping veterans who have received neuropsychiatric discharges from the Armed Forces to fit themselves back into civilian life.

St. Elizabeths Hospital, American Red Cross

Miss Margaret Hagan plans to use psychodrama techniques in a training program for Red Cross workers.

Social Psychology of Anti-Semitism, New Psychodrama Monograph

A new Psychodrama Monograph, Number 17, by Dr. Gustav Ichheiser, Talladega College, is being prepared by Beacon House, with the above title.

Veterans Rehabilitation Committee, Psychodramatic Institute, New York City

Veterans rehabilitation centers, army reconditioning hospitals, Red Cross units, using psychodrama and group psychotherapy may write for literature and further information to the committee at the Psychodramatic Institute, 101 Park Avenue, New York City.

Publication Program, Sociometry 1945

The May issue will contain a symposium on *Sociometry and Current Events*. Among the contributions are "How Russia Will Look Twenty-five Years from Now," Pitirim A. Sorokin; "Sociometry and Fascism," Bruno Solby; "Social Psychology of Anti-Semitism," Gustav Ichheiser; "Postwar

Social Research," by George A. Lundberg. Further contributors are Kurt Lewin, Theodore R. Sarbin, J. L. Moreno, and others.

The August issue will deal with *Sociometry and Psychiatry* and the November issue with *Sociometry and Economics.*

Members of the A.S.A. and Sociometric Publications.

Annual dues for membership are $5.00, from which $4.00 go towards the subscription to *Sociometry.* Beacon House has agreed to give a reduction of 25% on all its books and monographs to members.

Report of the Research Group, New York Psychodramatic Institute

Interest in the operational methods of psychodrama and sociometry has expanded into the colleges and universities of New York City, as well as elsewhere. Research work at the Institute continues to uncover fresh material in the fields of diagnosis, therapeusis, and prevention.

Mr. Paul Cornyetz, co-chairman of the Research Group, has been recommended to lecture in a course of Sociometry at Teachers College, Columbia University. He is also scheduled to discuss psychodramatic techniques this fall in Professor Tomlinson's course in projective methods, as well as in other courses at New York University. *Mr. John Del Torto,* co-chairman of the Research Group, will teach a course in psychodrama and sociometry at the University of Denver in Colorado. During the summer, Mr. Cornyetz will direct a number of sessions at the New York Psychodramatic Institute. *Mr. Tierney* and his co-workers are conducting a Wednesday evening Research Unit in a project to develop a situational approach to the problems of diagnosis. When completed, the work will complement the Data-Guide prepared by Mr. Paul Cornyetz and Mr. John Del Torto for the operational analysis of projection and expression.

Dr. George A. Lundberg, Chairman of the Department of Sociology, University of Washington at Seattle

Dr. George A. Lundberg, editor of *Sociometry,* has been appointed as head of the Department of Sociology at the University of Washington at Seattle, effective October 1st, 1945.

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